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WAYNE G. BRANDSTADT, *Colonel, MC, U. S. A., Editor-in-Chief*
ROBERT J. BENFORD, *Colonel, U. S. A. F. (MC), Associate Editor*
HAROLD A. LYONS, *Commander, MC, U. S. N., AssociateEditor*

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# Foreword

The UNITED STATES ARMED FORCES MEDICAL JOURNAL represents the unification of the BULLETIN OF THE UNITED STATES ARMY MEDICAL DEPARTMENT and the UNITED STATES NAVAL MEDICAL BULLETIN. This joint periodical is the medium for disseminating information of administrative and professional interest to all medical personnel of the Department of Defense.

The Chairman of the Armed Forces Medical Policy Council and the Surgeons General of the several services invite all medical officers, dental officers, Medical Service Corps officers, Nurse Corps officers, and officers of the Veterinary Corps of the Armed Forces, and the medical consultants of the Army, Navy, and Air Force to submit manuscripts for publication in this JOURNAL.

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*Surgeon General, U. S. Army.*

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WAYNE G. BRANDSTADT, *Editor-in-Chief,*
*Colonel, Medical Corps,*
*United States Army.*

ROBERT J. BENFORD, *Associate Editor,*
*Colonel, Medical Corps,*
*United States Air Force.*

HAROLD A. LYONS, *Associate Editor,*
*Commander, Medical Corps,*
*United States Navy.*

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OFFICE OF THE SECRETARY OF DEFENSE
ARMED FORCES MEDICAL POLICY COUNCIL
WASHINGTON 25, D.C.

MEMO: Personnel of the Medical Services of the United States Armed Forces

Department of Defense supplies of dried human blood plasma have been gravely depleted by the demands of the Korean campaign. It is imperative that every possible effort be made to assure the continued availability of blood plasma for military purposes and in adequate supply at all times ready for use.

The Department of Defense is immediately beginning a continuous and vigorous campaign, in conjunction with the Red Cross, to persuade the civilian and military population to contribute whole blood to the Armed Forces. Full cooperation by all echelons of the three services is urged in convincing the civilian population and military personnel of the vital military necessity of supporting this program. An Armed Forces Blood Donor Program has been established within the framework of the campaign, which is to obtain blood from service personnel on military bases within the continental United States. Existing medical facilities and personnel will be used to the greatest possible extent. The Armed Forces blood donor portion of the program will be under the policy guidance of the Armed Forces Medical Policy Council and general direction and control has been assigned to the Directorate of the Armed Services Medical Procurement Agency. All local Armed Forces Blood Donor Programs will be submitted to the Directorate for approval prior to actual collection of blood in order to avoid waste.

I know that all military medical personnel will actively support and participate in this most vital Blood Donor Program.

W. Randolph Lovelace, II, M. D.
Chairman

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# Field Use of Methadone and Levo-Iso-Methadone in a Combat Zone

(Hamhung-Hungnam, North Korea)

Henry K. Beecher, *M. D.*
Philip A. Deffer, *Captain, MC, U. S. A.*
Frank E. Fink, *Captain, MC, U. S. A.*
Daniel B. Sullivan, *Captain, MC, U. S. A.*

IT IS possible that we may be cut off from sources of supply of opium and its derivatives. For this reason extensive studies were undertaken to ensure an adequate supply of pain-relieving agents to take the place of morphine. The goal was to find an agent at least as good as morphine and which can be made from cheap and common chemicals. This objective has met with some success. In this, the prolonged support not only of the Medical Research and Development Board of the Office of the Surgeon General of the Army must be mentioned, but also the Committee on Narcotics and Drug Addiction of the National Research Council and the National Institutes of Health of the U. S. Public Health Service.

Thousands of clinical uses of members of the methadone family in controlled studies at the Massachusetts General Hospital (*1-5*) and elsewhere (*6*) have made it clear, not only in studies of analgesic

(*1*) Denton, J. E., and Beecher, H. K.: New analgesics: I. Methods in clinical evaluation of new analgesics. J. A. M. A. 141: 1051-1057, Dec. 10, 1949.

(*2*) Denton, J. E., and Beecher, H. K.: New analgesics: II. Clinical appraisal of narcotic power of methadone and its isomers. J. A. M. A. 141: 1146-1148, Dec. 17, 1949.

(*3*) Denton, J. E., and Beecher, H. K.: New analgesics: III. Comparison of side effects of morphine, methadone and methdone's isomers in man. J. A. M. A. 141: 1148-1153, Dec. 17, 1949.

(*4*) Keats, A. S.; Beecher, H. K.; and Mosteller, F. C.: Measurement of pathological pain in distinction to experimental pain. J. Appl. Physiol. 3: 35-44, July 1950.

(*5*) Keats, A. S., and Beecher, H. K.: A comparative study of the effects on the respiration of methadones, morphine, and barbiturates. Unpublished work in progress, 1951.

(*6*) Troxil, E. B.: Clinical evaluation of analgesic methadone. J. A. M. A. 136: 920-923, Apr. 3, 1948.

power, but also in studies of side effects, that two of the best agents, racemic methadone (6-dimethylamino-4, 4-diphenyl heptanone-3) and levo-iso-methadone (6-dimethylamino-5-methyl-4, 4-diphenyl hexanone-3), were at least as good as morphine, and in the latter case, better. These agents can be synthesized relatively easily from readily available materials.

Before any sweeping decisions were made as to morphine stockpiles, it appeared desirable to give these agents a field trial, lest difficulties arise there that were neither encountered nor foreseen in civil life. This report gives an account of such a field trial, in two types of installation, forward and rear. An evacuation hospital was the scene of the forward trial. It was at that time situated at Hamhung, North Korea, about 35 miles from the Chosin-Chungjin Reservoir where the Chinese Armies were massed. This hospital was in the most forward position at the time of the trial and received wounded men by air evacuation directly from the place where they fell near the reservoir. The temperature there was 27° F. below zero. Some idea of the proximity of this installation to the front can be given by recording that on the first night of the study, enemy troops were around the hospital three times. Ambushes were common and men wounded locally were also cared for. The tests in the rear were carried out at the Tokyo Army Hospital.

## PROCEDURES

In the publications from our laboratory previously referred to, we have emphasized the importance of appraising the effects of all analgesic drugs without knowledge of their nature, at the same time pitting the new agents against a placebo of saline solution on one hand and a standard dose of morphine on the other hand. These standards were maintained in the rearward studies; but in the forward work (Hamhung) only one observer was available. Here objectivity was preserved as well as possible by a mechanical rotation of the agents employed whenever pain warranted the use of a narcotic, and by avoiding any inspection or summation of data until the entire study was completed. The similarity of the data obtained both at Hamhung and at Tokyo with the large civil trial in Boston indicates that objectivity of appraisal was carried out, even though the conditions in the forward area were not ideal.

*Patients.*—At Hamhung, attention was focused chiefly on the freshly wounded; at Tokyo, on postoperative patients. Only patients having persistent, steady wound pain, severe enough to require a narcotic and not primarily associated with movement, were included in the study. Patients who were uncooperative or who were in a clouded mental state were excluded. Sometimes patients complained of more than one type of pain, for example, headache and wound pain, or pain of a different type in two wounds. The narcotic may sometimes relieve one pain but not the other. We adopted arbitrarily the practice of judging

the effectiveness of the narcotic by its success in relieving the pain for which it was given. Pain caused by motion was not used because it is often impossible to relieve it entirely with reasonable doses of a narcotic.

*Observers.*—At Hamhung, because only one observer was available for the study, he made constant rounds of all wards throughout a 16- to 18-hour day appraising patients and giving narcotics according to the criteria mentioned above. A complete circuit required about 40 minutes, with interruptions to see patients on the study at 45 and at 90 minutes following medications. At Tokyo, three medical officers worked around the clock. Although without previous research experience, they were given a brief protocol to follow and 1 hour's indoctrination on the wards. Following this they were left alone for about a 2-week period. The identity of their results with those of observers with long experience supports the usefulness of the Denton and Beecher *(1-3)* method for measuring pain relief. This is emphasized by the fact that no equipment other than notebook and pencil is involved.

*Drugs.*—At Hamhung (1) racemic methadone, (2) levo-iso-methadone, and (3) morphine, all in 15 mg. individual dose; (4) a 1 ml. normal saline solution (placebo), (5) a solution containing 5 mg. of morphine with 50 mg. of pentobarbital sodium, and (6) a solution containing 100 mg. pentobarbital sodium were used. Five of these solutions (all except the mixture of barbiturate and morphine) came in individual ampins under gas pressure (so that the drug would be delivered automatically when the stem of the ampin was broken within a rubber tube attached at one end to the ampin and at the other end to a sterile needle). Fifteen milligram doses of the methadones and the morphine (alone) were used, because this is the dose proposed by others for military use. We should prefer to see 10 mg. doses used for military purposes. The mixture of barbiturate and morphine was dispensed in the usual manner from a stock bottle. These agents were rotated to the patients in a mechanical way.

At Tokyo, racemic methadone, levo-iso-methadone, and morphine, all in 10 mg. individual doses, and a 1 ml. normal saline solution placebo were used. Each was given a code number and they were rotated mechanically, without knowledge of what was being used. The 10 mg. dose of narcotic was used here, because we *(7)* have found that from 7 to 9 mg. give as much analgesic effect as 15 mg., a point too little appreciated in the clinical use of narcotics. This is supported further by the similar data obtained at Hamhung and Tokyo. Although we have shown separately the data obtained in the two places, we have not hesitated to combine them in a third table for the reason just stated. In the large civil study the 10 mg. doses of narcotic were given per 70 kg. of body weight. In order to simplify the military trials we used fixed total doses as indicated because all agents were admin-

*(7)* See table 6 of reference *(2)*.

istered to previously healthy young men in good physical condition. The differences in size would cancel out, for in this instance we were interested only in comparative not absolute data. It is doubtful if there would be any detectable difference here, in any case.

*Technic.*—The method of measuring pain relief as developed by Denton and Beecher (1-3) and Keats et al. (4) involves the use of groups of patients having steady wound pain. At specified intervals, in this case 45 and 90 minutes after administration of the drug, the patients were questioned as follows: "How do you feel now in comparison with the way you felt before you had the medicine?" "Do you still have your pain?" If the answer is "Less," "How much less is it?" "Is it more or less than half gone?" "Do you need more medicine for it?" The interview was recorded as positive when the pain was reported as more than half gone. Curiously enough, this is a distinction patients usually make easily. Anything less was recorded as negative. In this particular study pain alone was considered; comfort and pain relief were not differentiated here (4) and sleep, loss of anxiety, or restlessness were not considered. If the patient was asleep as the time for evaluation drew near, he was awakened. The rationale for this is discussed in the papers referred to. Occasionally a patient would insist that his pain was just one-half better, no more, no less. Such a result was discarded and not included in the evaluation. This is statistically sounder than a guess by the observer. We used the arbitrary convention that a "positive" result was necessary at both the 45- and 90-minute evaluation periods for a satisfactory result. A negative finding at either or both times resulted in a designation of the pain relief as unsatisfactory. The percentage of satisfactory doses of the total was the index used for comparing the several agents.

If, for some reason, say early evacuation of the patient, the 90-minute appraisal was not possible, the subject was dropped from the tally. If at the 45-minute interview the pain was even worse than before any medication was given, re-medication was permitted and the patient dropped from the study. (The pain state was not steady.) An attempt was made to await the return of the original complaints before the next drug was administered.

## RESULTS

The data obtained are shown in tables 1, 2, and 3. A test of the assumption of equality of the percent obtaining true relief from racemic methadone, levo-iso-methadone, and morphine in the doses used at Hamhung and at Tokyo, shows no evidence of differences. Now, pooling the results of the three narcotics from table 3 and comparing them with the combined outcome for the placebo gives a difference well beyond the 0.01 level of significance. These results are in excellent agreement with those obtained in the work at the Massachusetts General Hospital. There is no significant deviation in the combined Tokyo and Hamhung data from percents observed in the large civil trial of the agents. In

TABLE 1.—*Hambung data—54 medications in 43 patients*

| Result | Agent used and dose | | | | | |
|---|---|---|---|---|---|---|
| | 15 mg. of racemic methadone | 15 mg. of levo-iso-methadone | 15 mg. of morphine | Placebo | 5 mg. of morphine with 50 mg. of pentobarbital | 100 mg. of pentobarbital |
| Satisfactory | 9 | 9 | 7 | 2 | 9 | 4 |
| Unsatisfactory | 0 | 1 | 2 | 7 | 0 | 4 |
| Percent relief | 100 | 90 | 78 | 22 | 100 | 50 |
| Percent relief in large civil trial* | 80 | 80 | 80 | 20 | — | 50 |

*In the civil trial 10 mg. per 70 kg. of body weight was the dose used for morphine and the two methadones.

TABLE 2.—*Tokyo Army Hospital—78 medications in 46 patients*

| Result | Agent used and dose | | | |
|---|---|---|---|---|
| | 10 mg. of racemic methadone | 10 mg. of levo-iso-methadone | 10 mg. of morphine | Placebo |
| Satisfactory | 17 | 14 | 15 | 7 |
| Unsatisfactory | 3 | 5 | 4 | 13 |
| Percent relief | 85 | 74 | 79 | 35 |
| Percent relief in large civil trial | 80 | 80 | 80 | 20 |

TABLE 3.—*Combination of Tokyo and Hambung data*

| Result | Agent used | | | |
|---|---|---|---|---|
| | Racemic methadone | Levo-iso-methadone | Morphine | Placebo |
| Satisfactory | 26 | 23 | 22 | 9 |
| Unsatisfactory | 3 | 6 | 6 | 20 |
| Percent relief | 90 | 79 | 79 | 31 |

all cases the statistical testing was done on binomial probability paper as described by Mosteller and Tukey *(8)*.

## DISCUSSION

It is clear, whether one looks at the Hamhung sample, at the larger body of Tokyo data, at the combined material, or at the information obtained in a civil population, that either of the two methadones is as effective as morphine in pain relief. From the work at the Massachusetts General Hospital we know that milligram for milligram the racemic methadone is also the equivalent of morphine in side effects. It is too soon to say how the addiction liabilities will compare. This equivalence of side effects with morphine for the racemic methadone needs to be emphasized, for too many loose statements are made that the methadone is a great clinical improvement over morphine. There is no dependable evidence that this is so. It seems to be exactly as good, not better.

The statement is also made rather frequently that racemic methadone has less hypnotic effect than morphine. We *(1-3)* could find no statistical support for this in man in the most carefully controlled experiments we could devise. In this we considered 7 parameters in 29 normal men: sleep, drowsiness, pleasant affect, relaxation, fatigue, objective ataxia, and subjective ataxia. Had there been dependable differences in hypnotic effect between morphine and the racemic methadone, these differences should have been reflected in small probabilities in our significance tests. However, the probabilities observed were large, averaging about 0.5, with none less than 0.19. We are obliged to conclude that the common statement that methadone has less hypnotic effect than morphine, milligram for milligram, is not correct.

Denton and Beecher *(1-3)* showed, and in work in progress Keats and Beecher have confirmed, that there is demonstrably less nausea and vomiting in normal ambulatory men following the use of the levo-iso-methadone than after either morphine or racemic methadone. The racemic methadone is, however, valuable because (1) it is as good as morphine (but not better) and can be made relatively easily from readily available chemicals and (2) it can be substituted for morphine in addiction and the morphine addiction sustained as Isbell and his associates at the U. S. Public Health Hospital at Lexington have shown, with few or no withdrawal symptoms. The methadone can then be withdrawn promptly with the appearance of only mild abstinence phenomena.

Table 1 indicates that 5 mg. of morphine with 50 mg. of pentobarbital sodium is as effective as 15 mg. of morphine. This agrees with our

*(8)* Mosteller, F. and Tukey, J. W.: Uses and usefulness of binomial probability paper. Journal American Statistical Association 44: 174-212, June 1949. We wish to acknowledge with thanks Professor Mosteller's personal guidance in this statistical testing.

other clinical findings (9-11). In table 2 the only real difference between the civil experience and the Tokyo data is in the effectiveness of the placebo in the two studies. It is not surprising that we obtained a somewhat higher percentage of relief from the saline placebo in the Tokyo Army Hospital than at Hamhung and in our civil experience. As we have pointed out in a previous report (12), the wounded soldier passes from his first state of euphoria to a depressed, anxious state. This is often found at the military general hospital level. At this level the attention inherent in the injection procedure is of more importance than it is to the freshly wounded man. This perhaps is reflected in the higher percent of pain relief from the placebo. If these new agents are to be used in the Civil Defense program, it is our belief that they, as well as morphine, should be put up in 8-mg. dose size, whether in ampules, ampins, or syrettes. Many of these will be used in children, in cachectic adults, or in persons debilitated by wounds. It is easier to give two doses than it is to slow down the absorption of an already injected dose that proves toxic.

## CONCLUSIONS

Racemic methadone, levo-iso-methadone, a solution containing small doses of both morphine and a barbiturate, and pentobarbital sodium have been studied in a combat zone under rugged conditions. These agents have been compared with morphine and with a placebo (normal saline solution). This work with the methadones confirms our work in a civil hospital as to their analgesic effectiveness. Both the racemic and the levo-iso-methadone have exactly, milligram for milligram, the same power to relieve pain that morphine has. Experience with the barbiturate and with the combination of small doses of a barbiturate and morphine was found to be like that previously observed.

This work provided an opportunity to test the adaptability of our method for measuring pain relief (where the only physical equipment necessary is a notebook and pencil) to conditions of the field and to use by observers not previously experienced in research; yet they obtained the same percentage of pain relief with these agents as experienced observers. Emphasis is given to the fact that from 7 to 9 mg. of morphine will give as much pain relief as 15 mg., although the undesirable side effects are greatly increased in the latter case. Racemic methadone and levo-iso-methadone are neither better nor worse than

(9) Beecher, H. K.: Symposium on management of Cocoanut Grove burns at Massachusetts General Hospital; resuscitation and sedation of patients with burns which include the airway; some problems of immediate therapy. Ann. Surg. 117: 825-833, June 1943.

(10) Beecher, H. K.: Pain in men wounded in battle. Ann. Surg. 123: 96-105, Jan. 1946; also, Bull. U. S. Army M. Dept. 5: 445-454, Apr. 1946.

(11) Beecher, H. K.: Resuscitation and Anesthesia for Wounded Men, the Management of Traumatic Shock. Charles C Thomas, Springfield, Ill., 1949. p. 94.

(12) Beecher, H. K.: Preparation of battle casualties for surgery. Ann. Surg. 121: 769-792, June 1945; also, M. Bull. Mediterranean Theat. Op. 3: 223-236, June 1945. (See particularly p. 771.)

morphine in pain-relieving power. It is significant, however, that less nausea and vomiting are associated with the levo-iso-methadone than with the racemic methadone.

ACKNOWLEDGMENT: This study was made possible through the cooperation of the U. S. Army. It was arranged by the Medical Research and Development Board, Office of the Surgeon General.

# Thoracic Injuries in World War II

## II. Therapy in the Reconstructive Phase (1)

Joseph P. O'Connor, *Commander, MC, U. S. N. R. (2)*

ALL 309 patients with war wounds of the chest wall and lungs included in this study were received at a hospital on the mainland 2 months or more after the injuries were sustained. These patients had been divided into 3 classes for the consideration of definitive care. In class 1 were placed those requiring only simple or no treatment on arrival; in class 2, which included the largest number, were those requiring definitive treatment on admission; and in class 3 were those placed in a category for elective treatment.

The circumstances under which these casualties resulted varied. Likewise the immediate first-aid treatment they received was not the same or organized and, for the most part, not ideal. Some of these patients received excellent first aid and treatment in the acute phase, but owing to the long distances which had to be covered from the beach, atoll, island, or aboard combat ship to fleet and base hospitals and the time consumed from the latter via hospital ship and transport to large thoracic centers in mainland hospitals, the clinical course of the condition of these injured men was forgotten or overlooked along the way in some instances. Much credit is due to the physicians who first attended these men, for it could be seen that they were handled competently. These medical officers were in no way responsible for the changes or complications which would occur as the result of the injured being transferred from one medical activity to another. This study therefore is not confronted with such problems as shock, sucking wounds, pain in the chest wall, or mechanical problems of breathing.

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*(1)* Part I, General Considerations, Alterations of Pulmonary Physiology, and Therapy in the Initial and Reparative Stages, by Howard K. Gray, Captain, MC, U. S. N. R., and James D. Fryfogle, M. D., appeared in the August issue of this journal; and Part III, The Surgical Treatment of Traumatic Lesions of the Intrathoracic Cardiovascular Structures, by Herbert D. Adams, Commander, MC, U. S. N. R., will appear in the October issue.

*(2)* Pasadena, Calif.

## GENERAL CONSIDERATIONS

The types of thoracic surgical problems encountered when drafts of casualties were received included hemothorax, hemopneumothorax, simple effusion, empyema, foreign bodies in the chest wall and lung and mediastinum, bronchopleural fistulas, fibrothorax, diaphragmatic hernia, arteriovenous aneurysm, injuries to the brachial plexus, sinuses of the chest wall, and pneumothorax. Several of those wounded had a combination of thoracic and abdominal injuries and had associated orthopedic, plastic, and neurosurgical problems. A distinction between open penetrating and nonpenetrating injuries is not made except to mention that in a few patients hemothorax and even fracture of the ribs were sustained after exposure to blast.

Thought must be given to the benefit practically all these men received from the use of the sulfonamides in the early part of the Pacific conflict and later from the combined use of sulfonamides and penicillin. There can be no doubt but that these two agents used in conjunction with therapy for shock were valuable prophylactic weapons and prevented complications and sequelas, not to mention saving lives. Previous generous use of these agents may have misled many medical officers en route who would only see the patient for a short time. The clinical course was falsely masked and the patient's condition considered as satisfactory whereas sometimes a large hemothorax, sterile abscess, or even empyema was allowed to exist unnoticed.

## PRELIMINARY EXAMINATIONS

All of the patients included in this study were examined roentgenographically and fluoroscopically when first seen. Posteroanterior, lateral and oblique views, and lordotic, lateral decubitus, and heavy Bucky penetration roentgenograms were made when indicated. Because weeks had elapsed between the date of injury and the date of admission to our service, a few patients showed almost complete clearing of previously treated hemothorax, pneumothorax, and pneumonitis induced by "concussion" injuries. Some of these patients had practically normal-appearing chests and clear pulmonary fields on our first examination. Many of the patients with class 1 lesions and with normal parenchymal findings showed single or multiple fractures of the ribs, some with only a spray of metallic fragments. Very few instances of infection of the ribs were noted, and this may have been due to the administration of sulfonamides and penicillin.

## CLASS 1 PATIENTS

These patients required little of our attention. Their treatment was almost completed in the acute phase of their injuries when the principles of the treatment of shock, the arrest of hemorrhage, the correction of disturbed cardiorespiratory function, and the prevention of infection were inaugurated. Many were evacuated because of a small hemothorax or effusion which had cleared up en route; others had been

variously treated by transfusion, suture of a sucking wound, and removal of a foreign body at forward bases. A few had small effusions which appeared to be subsiding and were retained on the ward until clearing occurred. Several had moist granulations that filled old chest-wall sinuses which soon healed. Forty-nine of this class had sustained through-and-through bullet or shell fragment wounds associated with hemothorax. On admission to our hospital, the pulmonary fields were practically normal and roentgenograms showed little evidence of the previously described hemothorax as recorded in the health records of these patients. Several combined abdominothoracic wounds involving the liver, diaphragm, spleen, stomach, colon, and lung were repaired aboard ship immediately after injury and were no problem on arrival at our hospital.

## CLASS 2 PATIENTS

Although definitive treatment has for its aim the use of various surgical procedures to restore normal anatomy and functions of the thoracic structures, most of the problems on our service originated from the various sequelas of hemothorax.

*Hemothorax.*—Practically all wounds of the chest, penetrating and nonpenetrating, are associated with hemothorax of varying degree. This collapses and compresses the lung and in time the blood becomes clotted. In the interim an excellent culture medium for bacterial growth is afforded. Replacing air after aspiration is unnecessary and only invites unwarranted complications. The air maintains collapse of the apex and, should infection intervene, the empyema may become very large or even total instead of small and limited at the base when the upper pulmonary field is allowed to re-expand and become adherent to the chest wall. Most wounds which penetrate the pleural cavity, and even those causing parenchymal damage, allow admission of air to set up the clotting mechanism even before the hemothorax becomes advanced and therefore added air only enhances clotting.

Of the 309 patients, 276 (89 percent) had hemothorax either on evacuation or on arrival at our hospital. To begin with, in all instances patients with hemothorax were immediately aspirated with a 15- or 16-gage needle and the procedure was repeated at least every 36 hours. We were able to clear up the condition by aspiration alone and without surgical intervention in 121 (39 percent) of the entire series. Several of these patients were aspirated only once and 30 cc. was the smallest amount of fluid obtained. Penicillin was always instilled after aspiration. Many of the 121 patients underwent thoracentesis repeatedly because the pleural cavity was small; the clotted material interfered with aspiration only to a minor degree, and although the finally "dried-out" pleura remained thick, the benefit to be gained by thoracotomy would not have been enough to warrant surgical risk. In many instances the hemothorax was called "effusion" because the fluid obtained approached the typical straw color. Most class 2 patients were returned

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to duty. In this group of 121 patients the number who never previously had undergone aspiration and the number who had undergone aspiration prior to admission to the sick list at our hospital were about equal. Just why, in such a large number of patients, the hemothorax should clear up without the complications of clotting and serious infection cannot be explained. We first noticed that the injuries of a few of the men who had through-and-through bullet wounds cleared up after only a minor hemothorax. It was thought that bullets passing through the body at high speed caused no injury to intercostal vessels and only a minimal insult to the parenchyma of the lung. Later, patients with identical injuries first came to us with almost total empyema so this theory was abandoned.

*Technic.*—The same technic for aspiration and local anesthesia was used in every case. Roentgenograms in the various views and Bucky exposures were studied. As a rule, a site in the midaxillary line was chosen without any attempt to place the needle in the most dependent interspace. When fluid was difficult to obtain, change to a 2- or 5-cc. syringe often brought success. The original specimen was used for bacterial study and if it was found to be infected, examination for penicillin-resistant and penicillin-sensitive organisms completed the initial routine. Much diligent work was attempted to rid the pleural cavity of the fluid, debris, and clots. Sodium citrate, physiologic saline, azochloramid, and tyrothricin solutions were used in pleural lavage, depending on the nature of the aspirated material, and in many patients a long-standing hemothorax was evacuated and the lungs were re-expanded. This same procedure was followed even in the patients with a slight empyema when large amounts of penicillin were instilled after the lavage. Empyema in 18 of 68 patients was thus cleared up without resort to surgical measures.

This definitive treatment of late or "old" thoracic injuries does not differ from the handling of hemothorax in the acute phase because the treatment of choice is rapid re-expansion of the lung; this can be accomplished only by repeated aspiration which is done without replacement of air. Early in the war such a statement seemed to be rather dogmatic because the old teaching, especially that used in prewar civilian practice, was to regard hemothorax in a conservative manner, hoping that the blood would absorb by itself.

Our statistics compare favorably with those of others in regard to the status of the patients with hemothorax at the time they reached us, when considered from the standpoint of whether or not they had undergone aspiration previously. One writer found that 17 percent of 200 patients who had undergone aspiration prior to admission to the base hospital had experienced the development of empyema, while 46 percent of 74 who had never undergone aspiration were found to have empyema. Our figures show that in 13 percent of 200 patients empyema developed even though aspiration was carried out prior to admission, while in

54 percent of 80 cases of hemothorax in which aspiration had not been previously performed empyema followed.

*Chronic hemothorax and decortication.*—In our patients with "chronic, clotted hemothorax," the fluid obtained by aspiration had a prune-juice color and was small in amount even though physical and roentgenologic examination of the chest indicated flatness and a massive opaque density. Many of these lesions were not infected, as determined by smear and culture. After many attempts at aspiration, enough fluid was removed so that the roentgenogram showed multilocular pockets with many fluid levels. A major thoracotomy was performed, widely opening the pleural cavity to remove the fibrin and fibrous pockets

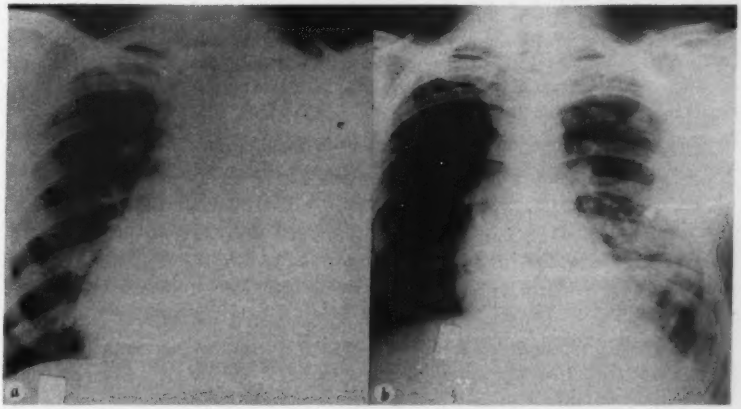

*Figure 1.*—(a) *Massive chronic hemothorax requiring decortication.* (b) *Post-operative results showing retained foreign body.*

that contained the prune-juice-colored fluid and also yellow custard-like clumps of old clotted blood. This was followed, in 9 patients, by decortication of a tough, rigid, thick, fibrous layer which was deposited on the parietal and visceral pleura to imprison and keep the lung compressed in a corsetlike vise (fig. 1).

For decortication the thorax was opened widely with a curvilinear incision in the same manner as would be used for exploratory thoracotomy for pulmonary resection; intratracheal anesthesia was used. All fluid and the custardlike clotted material were scooped up and wiped out. Dissection of the organized, fibrous peel on the lung was then carried out. Closed suction with a Stedman pump or underwater seal, if the area of decortication was small, was always carried out postoperatively.

Fluid and pus developed in 4 of these patients, but cleared up with aspiration and without further surgical treatment. One other patient with a sterile "chronic, clotted hemothorax" in whom decortication

was performed developed empyema in spite of closed, suction drainage, and further surgical intervention was necessary. In 3 patients, so-called infected, chronic hemothorax likewise became complicated by empyema and required rib resection. Two of the 4 decortications which were failures were performed 12 and 14 weeks after injury respectively, and when the thick peel was dissected, serum and blood oozed from the thin visceral pleura of the lung. It seemed that the peel formed a tight symphysis with the lung, with fibrous adhesive bands extending down through the visceral pleura and even into pulmonary tissue. None of the patients with hemothorax reached our service less than 6 weeks after injury; most came after longer duration. Usually aspiration was tried first for an average period of 2 weeks. This made the scheduling of decortication from 8 weeks upward after injury, which was not ideal from the standpoint of time. The dissections were prolonged and tedious. Although we were enthusiastic about this procedure which eliminated a deforming thoracoplasty, the time elapsed following injury explains the relatively few decortications which our service performed in comparison with the experience of others.

*Empyema* was the greatest problem in 68 of the 309 patients. In many of the class 2 patients empyema developed soon after injury; they had been variously treated by closed intercostal drainage with a catheter, flap operations, open thoracotomy, and some by multiple thoracenteses with further injection of penicillin prior to admission to our hospital. The incidence of empyema was 22 percent.

Hemothorax or thoracic injury may result in the development of empyema no matter how ideal and diligent the treatment. In some patients the empyema was caused by poorly treated hemothorax, improperly timed open or closed drainage, sucking wounds which sloughed after repair, the presence of persistent bronchopleural fistulas, or from foreign body reaction. Just as we were amazed to learn from the health records of some of those injured that a large hemothorax cleared up without ever being aspirated, likewise we had difficulty in understanding the fact that purulent fluid appeared a week or two after injury in some patients. What else besides bullets and shell fragments were carried into these injured chests can only be left to the imagination. Chemotherapy and penicillin shared in cutting down sequelas and morbidity. On the other hand these agents rendered a false clinical impression while an unattended hemothorax was being transformed into sterile pus and was in need of drainage.

Classic methods of drainage were effectual in 29 of the total number of patients with empyema. In none of these did the residual cavity have a capacity of more than 150 cc. All operations were performed in one stage, and while a long thoracotomy incision was made, segments of only 1 to 3 ribs were removed. Convalescence lasted from 2 to 10 weeks. In none of these patients was there any remaining thoracic deformity. The same is true of the previously mentioned 18 pa-

tients with empyema in whom the condition was cleared up by aspiration and instillation of penicillin.

Twelve patients had thoracoplasty in stages and 9 had one-stage procedures in which ribs and the thick pleural roof of the empyema cavity were removed and muscle transplants were used to fill in the defect. Of these 21 patients, 12 had varying, visible, thoracic deformity. In one patient a lung abscess, complicating a hemothorax which followed pneumonitis and atelectasis, necessitated a lobectomy.

## CLASS 3 PATIENTS

Class 3 patients consisted of those for whom surgical treatment was elective. For the most part the operation consisted of removal of foreign bodies in the chest wall and the pulmonary parenchyma. In addition, 3 foreign bodies were removed from the diaphragm and 2 from the mediastinum, 3 diaphragmatic hernias were repaired, and 3 arteriovenous or false aneurysms were treated. All class 3 patients were given 2 to 4 months after the date of injury before surgical treatment was undertaken, in order that the patient might recover and gain weight and strength and that all possibilities of intrathoracic infection and pleural reaction might be eliminated.

One of the false aneurysms resulted in the only fatality in the 309 patients. This man had been returned to duty overseas after receiving a through-and-through bullet wound of the right upper part of the thorax which healed quickly and without hemothorax. Later he was readmitted to the sick list because of hemoptysis. On the patient's admission to our hospital the roentgenograms revealed a shadow in the extreme apex of the right lung. While allowing his general condition to improve, he experienced an almost fatal hemoptysis. Large amounts of blood were given by transfusion and in an emergency operation a large aneurysmal sac connecting the subclavian artery with the apex of the right lung was found and the lung was repaired. The fibrous sac was being closed to be removed later when the man died on the operating table.

*Foreign bodies.*—Removal of metallic foreign bodies from the lung did not present much of a problem. For the surgical approach much the same technic as for pulmonary resection was used. Postoperative closed, underwater, or suction drainage was used followed by early ambulation.

Bullets and large shell fragments in the lung were removed after consideration of the size, proximity to important structures (fig. 2), and the likelihood of future inflammatory and abscess reaction. The minimal size for removal was set at 1 by 2 cm. Many of the patients in this study had metal fragments the size of a pinhead, and the size ranged up to 5 by 10 by 15 mm. Three patients had a regular salt-and-pepper effect, and the possibility of pulmonary resection was considered because of the extremely large number of tiny fragments. Finally they were discharged from the sick list without surgical intervention after a rather long period of observation.

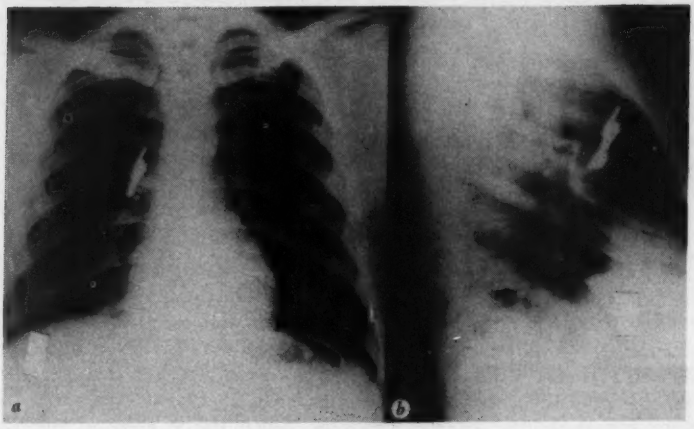

*Figure 2.—A foreign body lies close to vital structures.* (a) *Posteroanterior view.* (b) *Lateral view. The size and location of the retained foreign body make removal mandatory.*

*Tissue response.*—It was surprising to note the small amount of reaction around so many of the retained foreign bodies in just a few months following the injury. The missile tracts, for the most part, healed early, and the hemothorax and effusion usually cleared up. This course was characterized by clinical improvement and by progressive healing of the lesions as determined by successive roentgenologic examinations. It is always easy to imagine that a metallic foreign body could carry clothing or other debris with it through the thorax and into the lung and be the source of future infection. One large 2 by 2.5 cm. shell fragment removed from the lung was well encased in fibrous tissue, but on examination of the removed specimen, shreds of cloth were easily demonstrated on the metal. Another 1 by 1 cm. fragment shattered a lead pencil while passing through a pocket of the injured man. The fragment continued on into the lung and caused no reaction, while later the tract, which contained bits of lead and wood from the pencil, broke down and began to suppurate. The tract was excised but the fragment was not removed. Another fragment removed from an intercostal space contained a small amount of serous fluid in the fibrous capsule surrounding the metal. Much damage was produced by another fragment in a man who was admitted with extensive empyema which responded well to aspiration and treatment with penicillin. Re-expansion of the lung caused movement of the foreign body and it ultimately sloughed through the visceral pleura and dropped into the small remaining empyema cavity, producing a large bronchopleural fistula. Immediate rib resection was necessary and much surgical treatment was later required to eliminate the fistula.

*Localization technic.*—Exact preoperative localization of large fragments was most important. The method employed by our roentgenologist was simple and accurate. By fluoroscopic examination the position of the fragments was marked on the skin with a pencil. Metallic markers "A" and "P" were placed on the skin of the anterior and posterior chest walls near the fragment site and stereograms of the chest made (fig. 3). A true lateral roentgenogram of the chest also was made. The stereogram established the position of the foreign body in relation to the rib cage and the lateral view determined its position in relation to the anterior and posterior chest walls. This technic was supplemented later, following a suggestion by several authors, by taking a roentgenogram in the lateral decubitus position, duplicating the position of the patient on the operating table.

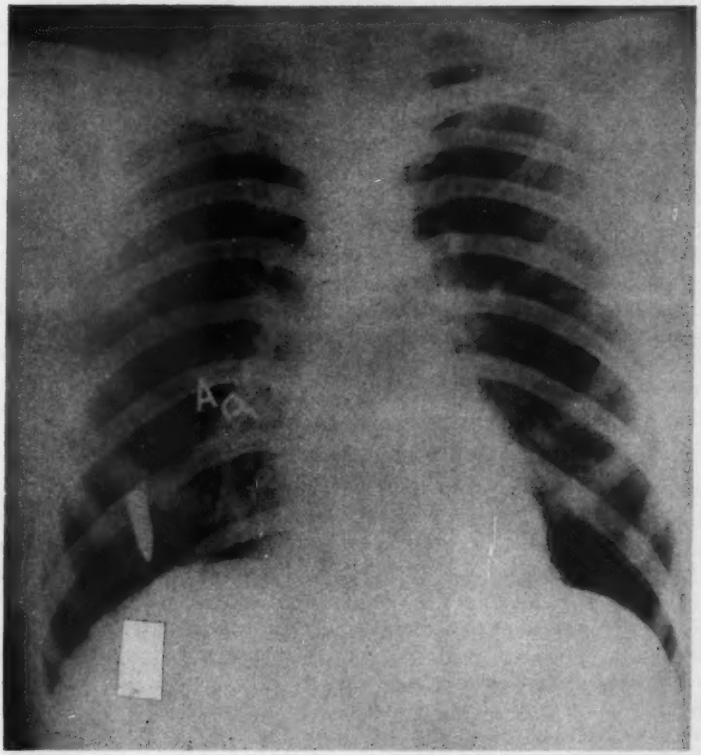


*Figure 3.—A foreign body is visible in the lower part of the right lung field, with anteroposterior markers in place for localizing the fragment.*

## POSTOPERATIVE REGIMEN

The usual postoperative procedures necessary for patients with thoracic injury were followed for the first 24 to 36 hours after which early ambulation was encouraged and exercises were started. Even patients too obviously ill to be out of bed for weeks were put through organized exercises supervised by the athletic instructors of the physical education and rehabilitation department together with the technicians of the physiotherapy section. As soon as the patient could sit up in bed and subsequently became ambulatory his exercises were increased to the point of tolerance under instruction.

## MUSCLE ATROPHY

A common finding in all cases of hemothorax and in other wounds of the thorax was atrophy of the pectoral and other muscles of the rib cage. In some, the atrophy was striking, the patient presenting on admission a visible deformity in just a few weeks after injury. Therefore, an important part of the immediate treatment became the exercises. The instructors and technicians stepped up the tempo of the physical activity as the clinical condition permitted, to the extent that such strenuous games as volleyball, basketball, and tennis became part of the treatment.

## EXERCISE PROGRAM

Many a young, frightened, and ill patient was admitted with a large hemothorax and one-half of his chest immobilized and apparently "stove-in," only to undergo thoracentesis once or twice and begin immediately with a regimen of exercises and suddenly change into a robust lad on the road to recovery. The reason for this is just as obscure as that for the cases of total hemothorax which cleared without aspiration.

## FOLLOW-UP DIFFICULTY

In an early report we mentioned that a certain large percentage of the injured were returned to full duty and a certain number to limited duty. Now, we believe that such a statement is unreliable because it was impossible to follow the condition of every patient released to duty from our ward. A few returned to us with rather indefinite complaints which were more psychosomatic than organic. Others most likely returned to the sick list elsewhere and still others may have been rehospitalized even after discharge from military service. The knowledge that they had retained foreign bodies or were told that they had a residual thickened pleural or the fact that they were instructed to guard against infections of the upper respiratory tract or the fact that they had had a thoracotomy and hence had a "weak chest" may be some of the reasons why the end results will be difficult to establish and why it will be difficult to know whether our work effected a cure or not.

## CONCLUSIONS

Three hundred and nine patients requiring late and definitive treatment because of traumatic lesions of the chest wall and lungs were divided into three classes. Class 1 consisted of those requiring little or no treatment after admission to our hospitals; class 2, those in need of definitive treatment on admission; and class 3, those admitted for elective treatment.

Most class 2 patients presented problems originating from the various sequelas of hemothorax. We are adamant in the statement that in all patients with hemothorax, in military or civil life, aspiration should be carried out early, often, and diligently and without air replacement. The purpose is to gain as rapid re-expansion of the lung as possible, to be followed by early ambulation and a regimen of graded exercises to eliminate the marked atrophy of the hemithorax. This reduces the incidence of "chronic, clotted hemothorax," empyema, atelectasis resulting in pulmonary suppuration, altered pulmonary function, and permanent disability of body deformity.

When the hemothorax can no longer be aspirated because of deposition of the products of clot and other debris in the visceral pleura, a large open thoracotomy should be performed to evacuate all this material which has the appearance of custard. If the lung is imprisoned and cannot fully re-expand, decortication should be performed. In some patients with hemothorax, sequelas will develop in spite of the most expert care.

Decortication is a procedure which merits our enthusiasm both for patients with infected hemothorax and for those with noninfected hemothorax, and ideally this operation should be performed no later than 6 weeks after injury. After this time the incidence of postoperative oozing caused by organized adhesions, accumulation of pleural fluid, and decrease in the normal elasticity of the lung is increased.

In empyema, the simplest and quickest approach to re-expansion of the lung and elimination of the infected space should be tried. This may run the gamut from aspiration with instillation of penicillin to adequate drainage by means of thoracotomy and decortication on to a deforming thoracoplasty.

Foreign bodies 1 by 2 cm. or greater should, as a rule, be removed as elective procedures. Proximity to important structures, such as the contents of the mediastinum, may necessitate removal of smaller fragments. Traumatic diaphragmatic hernias can be repaired as an elective procedure although as a rule this has been done in the acute phase of the injury in combination with repair of abdominal wounds. The sulfonamides and penicillin proved to be invaluable adjuncts.

# Reintroduction of Malaria Into the United States

SIGNIFICANT numbers of Armed Forces personnel from Korea are experiencing attacks of vivax malaria after their return to this country. Presumably these infections were acquired last fall though in some instances it is probable that symptoms were not manifested until spring because of prolonged incubation or the effects of suppressive medication. Medical officers should suspect malaria among patients presenting suggestive signs and symptoms, and who have been in Korea during the last year. Definitive diagnosis should be based on the demonstration of plasmodia in the blood. The chances of discovering parasites are much better in thick blood films than in thin ones.

Treatment with chloroquine, pentaquine, chlorguanide, and other antimalarial drugs will alleviate symptoms promptly. Some patients receiving complete courses of these drugs will remain free from malaria, but it is probable that others will relapse after weeks or months. Patients should be told of this possibility and advised to seek medical treatment again if symptoms recur. The likelihood of clinical reactivation becomes less with the passage of time. Relapses are rare after the second or third attack.

Residual insecticides should be applied to sleeping quarters within a mile of parasite-positive persons if the malarial vectors, *Anopheles quadrimaculatus* or *A. freeborni,* are known or found to be prevalent in the area. If competent diagnosis, adequate treatment, prompt reporting, and preventive insecticiding are achieved, it is believed that the present freedom of this country from endemic malaria will be maintained.

# Saline Solution in the Treatment of Injuries With Shock[1]

D. W. Richards, Jr., M. D.

## SALINE SOLUTION FOR PARENTERAL ADMINISTRATION

THE proper place of intravenous saline solution in the treatment of injured persons in shock can be adequately defined on the basis of existing knowledge. A large amount of work has been done on this problem, over many years, experimentally, clinically, and in battle casualties during World War II. Although certain questions remain unanswered and some differences of opinion persist, a general statement can be made to which most authorities, if not all, will agree. This will permit appropriate action to be taken by the Armed Forces and civilian defense agencies for procuring and stockpiling these solutions.

The function of saline solution as an element in the bodily economy is essentially kinetic and not static: saline solution tends to move through the body rather than remain in it. Normally a salt solution, after intravenous administration, is rapidly distributed throughout the body fluids and then rapidly excreted through the kidneys.

In the presence of dehydration, blood loss, and other conditions in which there is a net loss of tissue fluid, additional salt and water is needed for replacement over and above that required for urinary excretion. The same applies to conditions in which extra fluid accumulates in tissues, as in the edema of burns, crush injury, and infection. Sweating also uses up electrolytes and water. When these volumes are satisfied, again the basic need for added salt and water is for purposes of urinary excretion.

In acute shock, when blood or plasma is not available, saline solution rapidly administered intravenously can frequently restore and sustain the circulation for brief periods. After 1 or 2 liters of intravenous saline solution, a significant increase in plasma volume will

(1) Prepared for the Subcommittee on Shock of the National Research Council.

be maintained for perhaps 1 or 2 hours, as compared with 12 to 24 hours when blood or plasma has been given. Saline solution is also helpful in maintaining the patency of vein, needle, and tubing between transfusions. Additional saline solution has a special place in the treatment of burns, for the reasons above described.

In the general scheme of therapy, saline solution is a complement to blood or plasma and not a substitute for them. Parenterally administered saline solution is needed (1) to provide salt and water for dehydrated tissue depots, and (2) to provide salt and water for essential urine volume, in all instances where the injured person cannot take sufficient food, electrolytes, and water by mouth for these purposes. The basic criterion for saline requirement is urine volume, not plasma volume. In one clinical situation blood may be needed, and salt not needed at all; in another clinical situation, salt may be required for days or even weeks after the need for blood has passed. In still other situations, dextrose and water may be indicated rather than saline solution.

From the above, it is apparent that the use of saline solution parenterally is an essential part of the treatment of the injured person in shock, separate from but complemental to the use of blood, plasma, or plasma substitute. This Committee therefore recommends to the Armed Forces and Civil Defense the procurement of saline solutions suitable for parenteral administration for the treatment of wounds and burns, over and above, and separate from, the necessary supplies of blood, plasma, and plasma substitutes.

## SALINE SOLUTION FOR ORAL ADMINISTRATION

Because saline solution is chiefly needed to supply tissue depots and to provide for urine volume, saline solution by mouth, if it can be retained and absorbed, should be as effective as when it is given by vein. As supplementary and continuation therapy, therefore, in patients who are in condition to tolerate it, oral saline solution will be of value. It will be especially useful in burns of moderate severity or extent, if the patient is not in severe shock but requires additional salt and water in large amounts.

Oral saline solution like all other measures, must be administered only on physicians' orders. Indiscriminately used, especially if given to those in severe shock, it can do great harm, as for example: (1) through vomiting, with additional loss of salt and fluid; (2) through vomiting and aspiration, with the risk of aspiration pneumonia, or of immediate asphyxial death; (3) in abdominal injuries; and (4) when there is, for any reason, a tendency to pulmonary edema.

With the above reservations, measures which will provide oral saline solution for injured persons who are either not in shock or are in mild shock only are recommended to the Armed Forces and to Civil Defense.

To give an approximate indication of materials that can be used, and amounts required, a brief schedule of suggested therapy is appended.

## USE OF SALINE SOLUTIONS IN INJURIES WITH SHOCK

I. Parenteral (intravenous) isotonic saline solution: sodium chloride, sodium chloride and dextrose, sodium chloride and sodium bicarbonate, sodium lactate, Ringer, Ringer-lactate, et cetera.

1. Indications.

(a) Dehydration. Saline solutions are clearly indicated, and may provide complete relief of condition. Amounts, 1 to 3 liters, sometimes much more in severe dehydration, as in diabetic acidosis, cholera, et cetera.

(b) Shock due to or associated with massive blood loss. Useful as supplement to plasma or blood especially if there is added dehydration; or to sustain circulation for half to 1 hour while blood or plasma is being obtained. One to 2 liters of saline solution can maintain some increase in blood volume and cardiac output for 1 to 2 hours. Too much intravenous saline solution may overhydrate tissues and will eventually lead to venous congestion and pulmonary edema. Plasma protein levels will give indications of overhydration.

(c) Shock due to burns. Saline solution in larger amounts up to 3 or 4 liters daily may be useful as supplement to blood or plasma in extensive second and third degree burns during first 36 hours after injury. Caution after 36 hours as there is risk of circulatory congestion and pulmonary edema.

(d) Continuation therapy. When water and electrolytes cannot be taken by mouth in quantities sufficient to maintain urinary volume at normal or adequate levels, additional parenterally administered saline solution may be indicated.

2. Contraindications.

(a) Congestive heart failure (venous congestion, pulmonary and peripheral edema.

(b) Chest injuries (pulmonary edema).

(c) Burns involving tracheobronchial tree or lungs (pulmonary edema).

(d) Renal shutdown, unless actually due to dehydration or existing shock.

II. Oral saline solution. (Chilled isotonic or slightly hypotonic salt and sodium bicarbonate, or one-sixth molar sodium lactate, is more palatable than isotonic sodium chloride solution.)

1. Indications.

(a) Dehydration, when and if tolerated by gastrointestinal tract.

(b) Injuries with mild shock. One to 3 liters daily to relieve thirst and provide fluid and salt.

(c) Mild to moderate burns. If parenteral fluids are not available, saline solution, preferably chilled, can be taken by mouth in amounts up to 2 to 3 liters daily, provided patient's general condition is fairly good and there is no risk of aspirating vomitus. Patients sometimes vomit oral saline solution at first, but subsequently are able to retain it.

2. Contraindications.

(a) Severe shock or poor clinical condition with risk of vomiting and aspiration.

(b) Abdominal injuries.

(c) Inability to retain oral fluids.

(d) Renal shutdown, not due to dehydration or existing shock.

# Effect of Rapid and Prolonged Rewarming on Local Cold Injury[1]

Josef Pichotka, *M. D.*

Robert B. Lewis, *Lieutenant Colonel, U. S. A. F. (MC)*

THE RATE of rewarming a frozen limb has a decisive influence on the clinical result. The general belief is that slow rewarming is most beneficial and that direct application of heat to a frozen area is injurious and should, therefore, be avoided (2, 3). This assumption is based on popular observations that with slow rewarming alarming clinical signs and symptoms, such as marked swelling and severe pain, can best be avoided. These observations, however, are uncontrolled, and many of the examples quoted (4) to indicate the danger of rapid rewarming are open to doubt. In recent years several articles showing that rapid rewarming of frozen parts was not harmful but even beneficial have been published (5-9). The most important among these are those of Fuhrman and Crismon (6) and of Finneran and Shumacker (9).

(1) United States Air Force School of Aviation Medicine, Randolph Air Force Base, Tex.

(2) Greene, R.: Frostbite and kindred ills. Lancet 2: 689-693, Dec. 6, 1941.

(3) Greene, R.: Immediate vascular changes in true frostbite. J. Path. & Bact. 55: 259-267, July 1943.

(4) Sonnenburg, E., and Tschmarke, P.: Die verbrennungen und die erfrierungen. Neue Deutsche Chir. 17: 1-131, 1915.

(5) Arev, T. Y.: New data on pathology and clinical aspects of frost-bite. Sovet. vrach. zhur. 43: 391-402, Apr. 15, 1939.

(6) Fuhrman, F. A., and Crismon, J. M.: Studies on gangrene following cold injury; treatment of cold injury by means of immediate rapid warming. J. Clin. Investigation 26: 476-485, May 1947.

(7) Harkins, H. N., and Harmon, P. H.: Thermal injuries; effects of freezing. J. Clin. Investigation 16: 213-221, Mar. 1937.

(8) Lempke, R. E., and Shumacker, H. B., Jr.: Studies in experimental frostbite; evaluation of several methods for early treatment. Yale J. Biol. & Med. 21: 321-334, Mar. 1949.

(9) Finneran, J. C., and Shumacker, H. B., Jr.: Studies in experimental frostbite; further evaluation of early treatment. Surg., Gynec. & Obst. 90: 430-438, Apr. 1950.

These authors showed that rapid rewarming definitely decreased the tissue loss after a standard cold injury. Our experiments were performed in order to repeat the previous investigations with a method of cold injury which permitted a more exact quantification of the results. It was hoped, at the same time, that some insight might be gained which would result in a more clearly differentiating effect of rapid rewarming on frostbitten tissue.

## MATERIALS AND METHODS

The experiments were performed on 314 male albino rabbits of usually more than 2,500 grams body weight. The animals were exposed to three different degrees of local cold injury for which the results had been established in a large number of animals *(10)*. One hind leg of 310 animals, cleanly shaved and covered with a snugly fitting rubber condom, was immersed for 30 minutes in an alcohol bath of -10°, -12°, or -15° C., respectively, as described in another article *(11)*. After exposure, part of the animals were left to spontaneous rewarming of the frozen leg in air at room temperature. This group served as controls. Rapid rewarming was performed with 168 animals and was accomplished by immersing the frozen leg in a water bath at 42° C. (blood heat of normal rabbit is about 39° C.) until thawing was complete; the water was kept in constant motion. Some animals struggled for a short time in the warm bath, but thereafter no reaction by the animals was observed.

Legs exposed to -10° and -12° C. for 30 minutes were generally rewarmed for 5 minutes. At the end of this period, most legs were completely thawed; some still displayed denser areas in the upper calf. After exposure to -15° C. for 30 minutes, rewarming for 5 minutes often left large parts unthawed. Rewarming was continued in these cases until the solid areas were on the verge of disappearing. This usually required 2 or 3 additional minutes.

For the purpose of determining the effect of prolonged rewarming, 4 groups of 12 animals each were exposed to 2 standard cold injuries and immediately thereafter rewarmed for 15, 30, 60, and 120 minutes, respectively. In each group, 6 animals were exposed to -12° C. for 30 minutes and 6 to -15° C. for 30 minutes.

Rewarming was accomplished as described in the first part of this article. The temperature of the water bath was maintained at 42° C. throughout the period of rewarming. One hundred and forty-two animals were left to spontaneous rewarming of the frozen leg in air at room temperature as controls. Except for rewarming, all animals received the same treatment. The exposed leg was coated with marfanil

*(10)* Pichotka, J.; Lewis, R. B.; and Freytag, E.: Sequence of increasing local cold injury. Texas Rep. Biol. & Med. (in press).

*(11)* Pichotka, J. (Randolph Field, Tex.), and Lewis, R. B.: Use of heparin in treatment of experimental frostbite. Proc. Soc. Exper. Biol. & Med. 72: 130-136, Oct. 1949.

hydrochloride ointment and a sterile dressing applied *(12)*. This dressing was changed daily until the fate of the leg was apparent. The animals were kept at a constant room temperature of 25° C. and received a standard diet (purina). Most of the animals were sacrificed and examined on the seventh or eighth day after exposure, but some were kept for several weeks in order to study secondary changes. Four animals had both hind legs simultaneously exposed to cold for 30 minutes and one leg rapidly rewarmed in water at 42° C. for 5 minutes. The other leg was left to spontaneous rewarming in air at room temperature. For 2 of these the exposure temperature was -12° C. and for the others -15° C.

The extent of muscle necrosis was determined by weight. The leg was skinned down to the ankle and four muscles or muscle groups were separately prepared and weighed. These were: (1) the tibialis anticus plus the extensor digitorum longus, (2) the peroneus longus and the peroneus brevis, (3) the flexor digitorum longus, and (4) the gastrocnemius plus the soleus. The necrotic areas were usually sharply demarcated at the end of 1 week and were excised with scissors; the remaining healthy muscle was weighed again, and thus the proportion of necrotic tissue was determined. After the milder degrees of injury, necrosis was, as a rule, limited to the tibialis anticus and extensor digitorum longus. For this reason in two series of animals exposed to -10° and -12° C., respectively, the percentage of necrotic tissue was calculated with respect to the weight of these two muscles only.

In another article *(10)* we have shown that, contrary to the general assumption, muscular necrosis precedes the necrosis of the skin and subcutaneous layers in the sequence of increasing injury. Superficial necrosis means, in this report, gangrene of the skin and the subcutaneous layers and is measured in square centimeters. Cutaneous and muscular necrosis do not display a simple relationship and, as will be shown, can be independently influenced by therapeutic measures. It was, therefore, necessary to determine cutaneous and muscular necrosis separately in all experiments to gain insight into the effect of rapid rewarming.

## RESULTS

*Clinical findings.*—When the legs were removed from the warm bath, they had a deep gray-blue hue. This cyanosis disappeared in about 30 minutes and was replaced by the deep red color of superficial vasodilatation which quickly became diffuse. Strangely, when only the anterior muscle group was frozen solid, the cyanosis after thawing was limited to the skin over these muscles.

*(12)* Pichotka, J. (Randolph Field, Tex.), and Lewis, R. B.: Prevention of secondary infection due to Pseudomonas aeruginosa in frostbitten tissue. Proc. Soc. Exper. Biol. & Med. 72: 127-130, Oct. 1949.

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It was seldom observed in our experiments that animals left to spontaneous rewarming regained the use of the frozen leg after thawing. Especially, exposure to -15° C. for 30 minutes usually resulted in immediate partial flaccid paralysis. This was not true after rapid rewarming. Animals left to themselves after the leg was rewarmed in water at 42° C. for 5 minutes or more usually hopped with good use of the injured leg, but paralysis of the injured leg was noticed in some of these animals when their dressings were changed the following day. The latter was especially true in animals exposed to -15° C. for 30 minutes. Those exposed to -12° C. and rapidly rewarmed usually retained excellent function of the injured leg until the time of death, whereas the animals spontaneously rewarmed but exposed to the same injury showed varying degrees of paralysis.

The effect of rapid rewarming on the extent of the resulting edema was interesting. Even though the edema appeared more rapidly in rewarmed legs than in those left to spontaneous rewarming, it was not always more severe. With the lesser degrees of injury (-10 ° and-12° C. for 30 minutes) the edema in all groups was distinctly *less severe* and disappeared more quickly in the rapidly thawed legs than in those left to spontaneous rewarming. With the more severe injury (-15° C. for 30 minutes), the *extent of edema* in rapidly thawed legs was generally *less* than in spontaneously rewarmed legs. By comparison of these two groups, it was sometimes strikingly apparent that the extent of edema was not a reliable measure of the degree of injury. Animals with little or no final necrosis often displayed more edema prior to the development of necrosis than did animals which suffered extensive gangrene.

TABLE 1.—*Effect of rapid rewarming on the incidence of superficial necrosis in animals exposed to -12° C. and -15° C. for 30 minutes*

| Bath temperature | Number of animals | Treatment | Complete loss of leg | Number with superficial necrosis | Number without superficial necrosis | Died |
|---|---|---|---|---|---|---|
| -12° C. | 75 | Rewarmed in water at 42° C. for 5 minutes | 0 | 0 | 75 | 0 |
| | 51 | Rewarmed in air at room temperature | 0 | 13 | 38 | 0 |
| -15° C. | 39 | Rewarmed in water at 42° C. for 5 to 8 minutes | 0 | 3 | 35 | 1 |
| | 33 | Rewarmed in air at room temperature | 13 | 17 | 2 | 1 |

*Superficial (cutaneous) necrosis.*—The incidence and extent of cutaneous necrosis were determined by sacrificing and examining the animals on the seventh or eighth day after exposure. According to our

experience with rabbits, the final demarcation of the primary necrosis was complete at this time. Table 1 shows the incidence of superficial necrosis after rapid thawing and spontaneous rewarming in air for animals exposed to -12° and -15° C. for 30 minutes. The chi square test for the distribution of cases exposed to -12° C. with superficial necrosis was highly significant (P was less than 0.001). According to our experience *(10)* with this degree of injury, we could expect 15 of the 75 cases to result in superficial necrosis if they had been left to spontaneous rewarming.

In the group exposed to -15° C., the chi square test for the distribution of cases with and without superficial necrosis showed that this result was also highly significant (P was less than 0.001). According to our experience *(10)*, we could expect 35 of the 38 animals that survived to display superficial necrosis after this degree of injury if they had not been rapidly thawed.

The findings are still more convincing if the extent of skin necrosis is considered. In one experiment 24 animals were exposed to -15° C. for 30 minutes and quickly thawed in water at 42° C. for from 5 to 8 minutes, and 24 similarly exposed were left to spontaneous rewarming. In both groups 23 animals survived. In the rapidly rewarmed group, only 1 suffered skin necrosis amounting to 2 square cm. In the group left to spontaneous rewarming, 22 animals suffered skin necrosis with a total of 479 square cm. effected.

*Deep (muscular) necrosis.*—The effect of quick thawing on the extent of muscular necrosis was less clear. The first determinations of muscular necrosis were performed on a group of 54 animals exposed to -12° C. for 30 minutes. Eighteen of these were left to spontaneous rewarming at room temperature, and 36 were thawed rapidly by immersion in water at 42° C. for 5 minutes. After 8 days the animals left to spontaneous rewarming displayed the usual sharply demarcated, dull brown, indurated muscular necrosis. The extent of necrosis in this group was higher than usual, but still within the range typical for this degree of injury (table 2, series A).

The muscles of the quickly thawed legs looked different, as a rule. The distribution and localization of necrotic and nonnecrotic areas were exactly the same as in animals left to spontaneous rewarming. In general, when muscular necrosis was present in rapidly-thawed legs, the line of demarcation between viable and nonviable tissue was not distinct. The yellow or brown necrotic areas were separated from the definitely pink, living muscle by a narrow zone of gray or yellow-gray tissue. The percentage of muscular necrosis was calculated with respect to the total weight of the four muscle groups described previously.

The interpretation of the results of the experiments on muscular necrosis depends on the significance of the differences of the mean

TABLE 2.—*Effect of rapid rewarming on the extent of muscular necrosis in animals exposed to -10° C., -12° C., and -15° C. for 30 minutes*

| Number of animals | Series | Exposure temperature | Treatment | Interval between injury and autopsy | Muscular necrosis (percent) |
|---|---|---|---|---|---|
| 36 | A | -12° C. | Rewarmed in water at 42° C. for 5 minutes | 8 days | 43.0 ± 3.3 |
| 18 | | | Rewarmed in air at room temperature | | 48.1 ± 5.0 |
| 15 | B | -12° C. | Rewarmed in water at 42° C. for 5 minutes | 8 days | 49.7 ± 9.6 |
| 14 | | | Rewarmed in air at room temperature | | 63.9 ± 7.1 |
| 15 | C | -10° C. | Rewarmed in water at 42° C. for 5 minutes | 8 days | 25.5 ± 6.8 |
| 14 | | | Rewarmed in air at room temperature | | 42.6 ± 7.6 |
| 23 | D | -15° C. | Rewarmed in water at 42° C. for 5 to 8 minutes | 8 days | 55.9 ± 4.0 |
| 24 | | | Rewarmed in air at room temperature | | 69.9 ± 4.0 |
| 24 | E | -12° C. | Rewarmed in water at 42° C. for 5 minutes | 3 weeks | 6.5 ± 1.0 |
| 24 | | | Rewarmed in air at room temperature | | 20.8 ± 3.2 |
| 14 | F | -12° C. | Rewarmed in water at 42° C for 5 minutes | 5 weeks | 3.4 ± 1.5 |
| 8 | | | Rewarmed in air at room temperature | | 9.8 ± 3.4 |

values. Because our observations of "percentage of necrosis" do not show a normal distribution, a nonparametric test of significance was applied. The test used *(13)* provides for the calculation of a statistic which is distributed approximately as Student's "t." The results were not statistically significant. The "t" test yielded a P of 0.392 with 52 degrees of freedom. It was not possible to decide from the gross appearance whether those areas between necrotic and obviously viable tissue in the rapidly rewarmed legs would survive or eventually become

*(13)* Pitman, E. J.: Significance tests which may be applied to samples from any population. Supplement Journal Royal Statistical Society 4: 119-130, June 1937.

necrotic. There were indications that at least a large part of this changed tissue might only be in the state of severe atrophy. As shown in another article *(10)*, primary necrosis of muscle leads to an increase in weight, while a slightly lesser injury may result in marked atrophy with a loss in weight. In animals left to spontaneous rewarming, the muscles of the exposed leg showed on the average an *increase* in weight if compared to the unexposed leg of 4.3 percent, but the muscles of the quickly thawed legs *lost*, on the average, 2.8 percent by weight.

To gain more insight into the results of rapid rewarming, 30 animals were exposed to -12° C. for 30 minutes. Fifteen were thawed at room temperature as controls (1 died before the fate of the leg was determined) and 15 were rapidly rewarmed in water at 42° C. for 5 minutes. All animals were sacrificed after 8 days. With this degree of cold injury it has been our experience that in almost all instances only the anterior muscles of the leg (tibialis anticus plus extensor digitorum longus) show visible gross necrosis. For this reason, we disregarded the other muscles of the leg and determined only the percentage of necrosis in these two muscles. The gray tissue forming the border between necrotic and definitely viable muscle was not considered necrotic.

The mean muscular necrosis in the rapidly rewarmed and control animals is given in table 2, series B. The "t" test for the difference between the two groups yielded a P of 0.26 with 27 degrees of freedom. This was not significant.

Another group of 30 animals was exposed to -10° C. for 30 minutes. Fifteen were rewarmed in air at room temperature and served as controls (of this group, 1 died before the results became apparent), and 15 were rapidly rewarmed in water at 42° C. for 5 minutes. All animals were sacrificed and examined after 8 days. As in the preceding series, only the percentage of necrosis in the tibialis anticus and extensor digitorum longus was determined, since no other muscles became involved in the necrotic process with this degree of injury. Again, the gray zones bordering the necrotic areas were considered viable. The average muscle necrosis in the two groups is given in table 2, series C. The difference was not significant because the "t" test yielded a P of 0.1 with 27 degrees of freedom.

The extent of muscular necrosis in animals exposed to -15° C. for 30 minutes and rapidly thawed or left to spontaneous rewarming in air was determined 8 days after exposure in a group of 48 animals (table 2, series D). Of these, 24 animals were rapidly rewarmed in water at 42° C. (of this group, 23 survived), and 24 were spontaneously thawed at room temperature. The appearance of the necrotic parts in the rapidly and spontaneously rewarmed animals showed differences. In the spontaneously rewarmed animals the necrotic parts were compact and homogeneously discolored with sharp and straight lines of demarcation.

The necrotic areas were often sharply protruding at this line. In the rapidly rewarmed animals the demarcation between necrotic and nonnecrotic muscle was irregular but distinct with this degree of injury. Narrow or wide tongues of healthy tissue extended along the fascias into otherwise necrotic areas. At times tiny yellow areas of necrosis were scattered throughout viable muscle giving the tissue a speckled appearance. The necrotic parts were irregularly discolored, less indurated, and less protruding than in the other group. The percentage of muscle necrosis was calculated with respect to the four muscle groups described previously and the results incorporated in table 2, series D. There was a significant difference between the results in the rapidly and spontaneously rewarmed animals. ($P = 0.019$ with 45 degrees of freedom.)

One point concerning muscle weights deserves explanation. When the unexposed hind leg was used for comparison, the muscles of the spontaneously rewarmed legs showed, on the average, a 17.6 percent gain in weight, but the muscles of the rapidly rewarmed legs on the average maintained their total weight (the apparent gain of 2.1 percent is not significant). The weight increase occurred only in the necrotic parts; the remainder of the muscle tissue, on the other hand, displayed atrophy.

In figure 1, the extent of necrosis in 47 animals exposed to -15° C. for 30 minutes (23 rapidly rewarmed and 24 controls) is given with respect to the change in the total muscle weight of the exposed leg. The total muscle weight was decreased in cases with relatively little muscular necrosis in rapidly rewarmed animals because of atrophy of the surviving portion. More extensive necrosis was associated with a marked increase in total weight (in the spontaneously rewarmed animals). Because the gain in weight occurred exclusively in the necrotic part, the given proportion of the necrotic tissue was always too high. This deviation increased with increasing extent of the necrotic areas. For the purpose of establishing a difference between two groups of values with the same conditions, i. e., comparing legs exposed to the same cold injury, this behavior of the underlying function was of no concern because the function was in itself continuous.

There seemed to be a relation between the weight increase of necrotic muscles and the severity of injury by which it was caused. More severe injuries resulted in a more extensive necrosis and in a greater weight gain of the necrotic part. With rapid thawing this weight gain was diminished or prevented.

We are unable to interpret these results adequately. It is certain that rapid rewarming had a definite influence on the appearance of the injured muscles. In general this influence seemed to be beneficial, but whether the described differences in the appearance of the injured muscles were significant could be shown only by further experiments. Several groups of animals exposed to the same cold injury were sacrificed and examined 3 and 5 weeks after the exposure. We expected

*Figure 1.—Distribution of changes in muscle weight in rapidly and slowly rewarmed legs with respect to the extent of necrosis. Solid triangles represent muscle weights of animals rapidly thawed after exposure to cold injury. Open triangles represent muscle weights of animals left to spontaneous rewarming in air.*

that after this interval the fate of the muscles would be more apparent. The percentage of muscular necrosis was calculated with regard to the total weight of the four muscle groups described previously.

Forty-eight animals were exposed to -12° C. for 30 minutes (table 2, series E). Half of them were rapidly rewarmed in water at 42° C. for 5 minutes; the other half were left to spontaneous rewarming. Autopsies were performed 3 weeks after exposure. The leg muscles in both groups displayed a severe atrophy of the same order. The legs left to spontaneous rewarming lost an average of 21.5 percent of their total weight in comparison to the unexposed leg. Rapidly rewarmed legs lost an average of 24 percent as compared to the unexposed leg. The necrotic areas were compact, sharply limited, and without structure. There was a difference in color. Necrotic areas in the quickly thawed cases usually had a green hue, while the destroyed areas in the spontaneously rewarmed legs were gray-brown. The extent of the necrotic part was much different in the two groups. The average muscular necrosis for the two groups is shown in table 2, series E. Statistical analysis showed that the difference in the results of the two groups was significant at the 1 percent level. The "t" test yielded a P of 0.01 with 46 degrees of freedom. These values for the necrotic portion cannot be compared to those determined 8 days after exposure. After 3 weeks the total weight of the muscles was greatly decreased and part of the necrotic muscle tissue was absorbed and partially replaced with fibrous tissue. Nevertheless, we believe that the result is a good representation of the differences in the final injury.

A second series of 24 animals was exposed to the same conditions (-12° C. for 30 minutes) and sacrificed and examined 5 weeks after exposure. Fifteen of these animals were rapidly rewarmed until thawing was complete and 9 were left to spontaneous rewarming. One animal of each group died. At autopsy the atrophy was again of the same order of magnitude in rapidly and spontaneous rewarmed legs (20.9 and 17.5 percent, respectively). Of the 14 rapidly rewarmed legs, 10 were without grossly visible muscular necrosis. All 8 animals left to spontaneous rewarming displayed grossly necrotic muscle; the average muscle necrosis for all animals of this group is shown in table 2, series F. The results were significant at the 6 percent level P = 0.064 with 20 degrees of freedom). The fibrosis of the injured part of the muscles was much more pronounced in animals left to spontaneous rewarming.

Most convincing were the results in a group of animals exposed to -15° C. and sacrificed and examined 5 weeks after exposure. Of 24 animals 21 survived, 9 of which were left to spontaneous rewarming while the other 12 were rapidly thawed in water at 42° C. for from 5 to 8 minutes. Of the 12 animals rapidly rewarmed, none suffered superficial necrosis, and, with the exception of 1 animal which incurred a fracture in the ankle joint, they regained moderate to good use of the injured leg and foot. In 3 cases the spreading reflex of the toes was

restored. Of the 9 animals left to spontaneous rewarming, all but 1 suffered extensive necrosis of the skin, 2 completely lost a leg, and only 1 regained moderate use of the leg and foot after the cutaneous necrosis healed. In 7 of the 9 cases extensive liquefaction and sequestration were found in the muscles of the injured leg. In these cases even a moderate restoration was precluded. It was astonishing to see

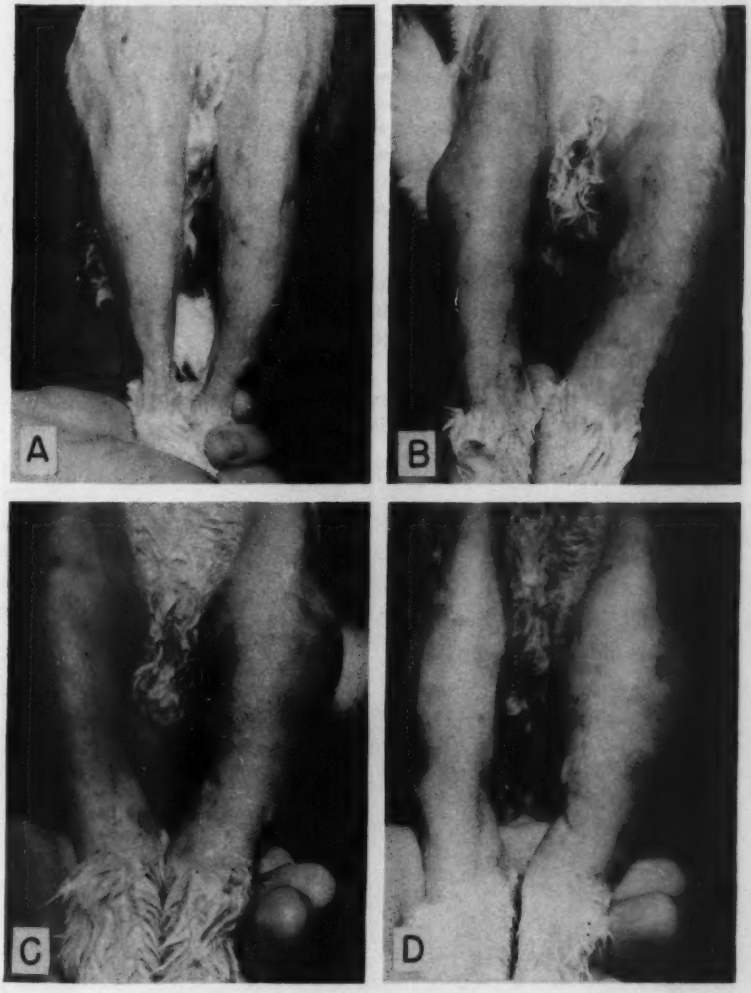


*Figure 2.—The edema of the rapidly thawed right leg (shown on left side) is much less than that in the spontaneously rewarmed left leg.* (A) *Fifteen minutes after exposure.* (B) *Two hours after exposure.* (C) *Five hours after exposure.* (D) *Twenty-four hours after exposure.*

that the tendons and fascias usually escaped necrosis, so that even small remnants of muscle tissue were still connected to their tendons.

There were no compact necrotic areas such as we observed from 1 to 2 weeks after exposure in the legs of animals left to spontaneous rewarming. The lines of demarcation were not straight as in spontaneously rewarmed animals but were distorted by many small processes of healthy tissue extending into the grossly necrotic areas. On cut surfaces many irregularly outlined small islands of surviving tissue could be found surrounded by necrosis. Especially, all connective tissue structures were accompanied by surviving muscle. These areas of viable tissue were often bordered by a fine hemorrhagic line. The necrotic parts were obviously slowly absorbed and partially replaced by fibrous tissue. There were no signs of liquefaction or sequestration of the necrotic muscle. Partial function of the atrophied and fibrotic muscles was obviously maintained. It was not possible quantitatively to compare the muscular necrosis in the two groups because of the interspersion of necrotic and viable muscle in the rapidly rewarmed animals and the liquefaction, probably secondary to infection of the necrotic skin, present in the gangrenous muscle in spontaneously rewarmed animals.

Better to compare the differences between the results of rapid and spontaneous rewarming, the following experiment was performed. Four

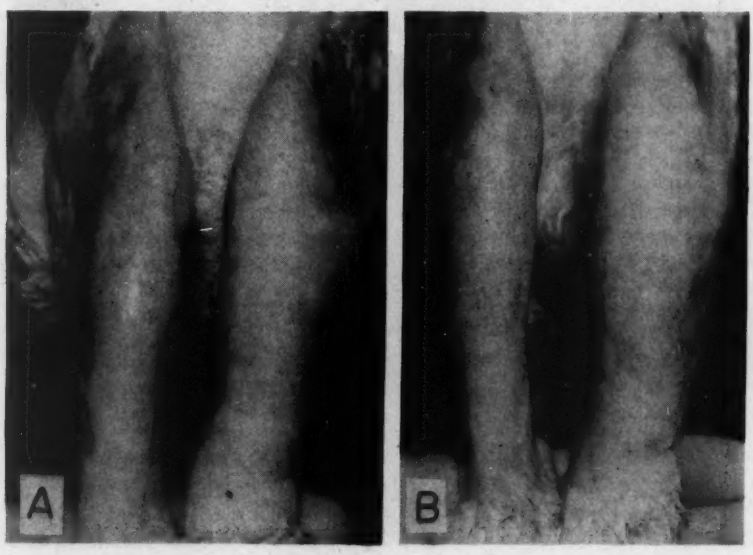


*Figure 3.—(Same rabbit as shown in figure 2.) The pictures taken after 2 and 3 days show the beginning of a limited superficial necrosis on the lateral aspect of the left leg.* (A) *Two days after exposure.* (B) *Three days after exposure.*

*Figure 4.—After 24 hours the rapidly rewarmed right leg (shown on left side) displayed the more extensive edema. The right leg at this time was not discolored, but an irregular cyanotic discoloration was present over the entire left leg. After 2 days large parts of the spontaneously rewarmed left leg became necrotic. The necrosis was more extensive after 3 days, at which time the edema of the right leg had almost disappeared, and the leg appeared quite healthy. The animal died from the cold injury 4 days after exposure. (A) Fifteen minutes after exposure. (B) Twenty-four hours after exposure. (C) Two days after exposure. (D) Three days after exposure.*

animals had both hind legs simultaneously exposed to cold injury; 2 animals were exposed to -12° and 2 to -15° C. for 30 minutes. After exposure the right legs of all 4 animals were rapidly thawed in water at 42° C. for 5 minutes, and the left legs in air at room temperature. The 2 animals exposed to -12° C. developed small areas of cutaneous necrosis on the spontaneously rewarmed legs. The rapidly rewarmed legs were without visible injury after 1 week (figs. 2 and 3). At autopsy of the animal shown in figures 2 and 3, 8 days after exposure, 16 percent of the muscle in the right leg and 44 percent of the muscle in the left leg was necrotic. The animals exposed to -15° C. showed no superficial necrosis of the rapidly rewarmed legs, while both legs of the animals left to spontaneous rewarming showed extensive cutaneous necrosis (fig. 4). At autopsy of the animal shown in figure 4, 79 percent of the muscle in the right leg and 76 percent of the muscle in the left left leg was necrotic.

## EFFECT OF PROLONGED REWARMING

The effect of prolonged rewarming on the result of a standard cold injury was investigated because it is important to know whether the beneficial effect of rapid thawing as described above will be increased or decreased by extending the period of rewarming. Furthermore, if the hypothesis that the necrosis after cold injury is caused by ischemia is correct, raising the tissue temperature and thereby increasing local metabolism would be deleterious. For this investigation 48 animals were divided into groups, exposed, and rewarmed in water at 42° C. for 15, 30, 60, or 120 minutes as previously described. The animals were sacrificed and examined from 6 to 8 days after exposure and the occurrence and the extent of cutaneous and muscular necrosis were determined. The results are shown in table 3.

The results for the animals exposed to -12° C. were on the average distinctly better than in animals similarly exposed and left to spontaneous rewarming. The extent of muscular necrosis in the group rewarmed for 60 minutes was in the same range as the average for spontaneously rewarmed animals, but this was obviously accidental. Such small groups are unduly influenced by a single high value, as was the case here. The results of exposure to -15° C. showed for all periods of rewarming the same magnitude of the extent of muscular necrosis and were in the same range as observed in similarly exposed animals spontaneously rewarmed. With regard to the occurrence and extent of cutaneous necrosis, the groups rewarmed for from 15 to 60 minutes were definitely better than animals left to spontaneous rewarming. The group rewarmed for 2 hours showed the same behavior as the other groups as far as muscular necrosis was concerned, but in all 6 animals of this group superficial necrosis occurred, as would have been expected with spontaneous rewarming. It is possible, but not certain, that this may have been the result of the prolonged rewarming.

TABLE 3.—*Influence of prolonged rewarming on the extent of muscular and cutaneous necrosis after exposure to -12° C. and -15° C. for 30 minutes*

| Bath temperature | Number of animals | Period of rewarming (minutes) | Extent of muscular necrosis (percent) | Cutaneous necrosis |
|---|---|---|---|---|
| -12° C. | 6 | 15 | 17 ± 2.9 | 0 |
| | 6 | 30 | 24 ± 5.3 | 0 |
| | 6 | 60 | 37 ± 12.3 | 0 |
| | 6 | 120 | 17 ± 4.4 | 0 |
| -15° C. | 5 | 15 | 66 ± 11.3 | 1 case with 6 square cm. |
| | 6 | 30 | 55 ± 7.6 | 0 |
| | 5 | 60 | 74 ± 3.6 | 0 |
| | 6 | 120 | 59 ± 7.9 | 6 cases totaling 100 square cm. |

## GENERAL OBSERVATIONS

The animals with quickly thawed legs appeared on the whole to remain in much better general condition than those left to spontaneous rewarming. As a rule, the latter lost weight in the week following exposure. This was not the case in animals whose legs were rapidly thawed. The weight loss was especially impressive when the different amounts of retroperitoneal fat were noted at autopsy. After quick thawing the animals in most instances maintained a normal amount of fat in this area, while after spontaneous rewarming the retroperitoneal fat largely disappeared. The incidence of severe diarrhea after exposure, a common feature after local cold injury, was much less frequent after quick thawing. Animals whose injured legs had been thawed rapidly did not exhibit the severe illness which was otherwise the rule. On the other hand, there were some particular features in the group of animals with rapidly thawed legs. They obviously suffered much pain from the injured leg. We observed in this group several animals which chewed off parts of the exposed but apparently healthy legs. According to our experience, this is unusual behavior in rabbits.

## DISCUSSION

The results of our investigation show convincingly that rapid thawing of a leg solidified by short exposure to low temperatures resulted in less extensive necrosis than slow thawing. With one standard cold injury (-12° C. for 30 minutes) resulting in partial necrosis of the skin in about 20 percent of the cases after spontaneous thawing in air, the occurrence of superficial necrosis was completely prevented by rapid thawing in water at 42° C.

More convincing still were the results of rapid thawing after exposure to -15° C. for 30 minutes. After spontaneous thawing in air, 90 percent of the animals usually displayed extensive necrosis of the skin. With rapid thawing, the rate was reduced to 3 of 38 animals, and the necrotic areas in these were small. Of 23 animals thawed spontaneously in air after exposure, 22 suffered from superficial necrosis of the exposed leg comprising a total area of 479 square cm. The corresponding group of rapidly thawed animals showed superficial necrosis in 1 of 23 cases amounting to 2 square cm. When extensive cutaneous necrosis occurred in our experiments the entire leg was lost. A surface necrosis of 30 to 40 square cm. invariably resulted in total necrosis of the leg. This total loss of the injured leg, occurring in about 40 percent of the cases when slowly thawed, was avoided by rapid warming.

The influence of rapid thawing on the extent of muscular necrosis was much less conspicuous, but, nevertheless, showed a definite trend toward improvement. In animals left to spontaneous rewarming, the extent of muscular necrosis was well defined after 7 or 8 days. At this time the compact necrotic areas were sharply demarcated. In animals with rapidly rewarmed legs the extent of the primarily affected area was obviously the same, but this area did not become completely necrotic. The necrosis after 1 week was well developed in most cases, but its outline was essentially irregular in comparison to the conditions in spontaneously rewarmed legs. The final result showed that islands of muscle tissue within the primarily affected areas survived. This surviving tissue was arranged as fingerlike processes or islands, usually in connection with fascias or other connective tissue structures.

Because of the decrease in the extent of the resulting necrosis of skin and muscle, rapidly rewarmed animals usually regained moderate or good use of the leg and foot even after exposure to -15° C. for 30 minutes. Animals left to spontaneous rewarming after the same degree of injury lost, primarily or secondarily, the exposed leg in almost half the cases and seldom regained a comparable degree of function. The liquefaction and destruction of the damaged tissue by pus formation, usually observed in these cases, were probably caused by late infection of necrotic parts of the skin.

The almost complete prevention of cutaneous necrosis by rapid rewarming showed that primary damage to the vessels cannot be the cause of the local gangrene. The reduction of the extent of muscular necrosis suggests the same conclusion. If damage to the blood vessels with subsequent thrombosis was the cause of necrosis following local cold injury, the favorable results of rapid rewarming would not be understandable. The thrombosis of large parts of the subcutaneous vascular system, which was often observed during the development of superficial necrosis, must, therefore, be secondary in the chain of

events. The basic injury must involve a process or system that is influenced essentially by rapid rewarming.

The distinctly lesser effect of rapid thawing in the prevention of muscular necrosis allows for either of two explanations. The susceptibility of muscle to cold injury is so much greater that, under our experimental conditions, the muscles were already largely damaged beyond repair, whereas the more resistant skin was saved by rapid rewarming. The other possibility is that the conditions of rewarming were much more favorable for the skin. Both explanations are supported by the facts.

Prolonged rewarming in water at 42° C. up to 1 hour did not produce deleterious results, but had the same beneficial influence as rapid thawing for only 5 to 8 minutes. The rapid increase in temperature and in local metabolism of the part injured by cold was obviously not harmful, but beneficial. This shows again that the concept of a primary interruption of the local circulation as the cause of the resulting necrosis cannot be correct. The extensive superficial necrosis after 2 hours' rewarming at 42° C. cannot be explained until we have further insight into the underlying mechanisms of local cold injury and the effect of quick rewarming.

With the few exceptions mentioned in the introduction, students of this problem insist on slow thawing and rewarming of frozen limbs. The popular observation that slow rewarming diminishes the appearance of edema and pain is certainly one of the premises of this conclusion, but this assumption received strong support from a rather general hypothesis, i. e., that the final cause of tissue necrosis after frostbite is the result of oxygen lack caused by the local interruption of the circulation by vasoconstriction, stasis with clumping of red blood cells, or thrombosis. From experiments which showed that tissue deprived of circulation survived longer the lower the environmental temperature, it was concluded that low temperature is most beneficial to frostbitten tissue *(14)*. The appearance of pain with increasing temperature of the affected part was construed to be a bad symptom. Prevention of pain by keeping the temperature in the injured part at a low level was, therefore, considered an important part of the treatment *(15)*. It is difficult to decide how far this concept is justified. The metabolic conditions of frostbitten limbs have never been investigated. Our knowledge concerning this has been derived from analogous situations.

A rational therapeutic approach has to consider the final outcome only, i. e., loss of tissue and impairment of function. Temporary symptoms, such as swelling and pain, are important only as they influence the final result. It would be important to know whether 42° C. is the

*(14)* Allen, F. M.: Surgical considerations of temperature in ligated limbs. Am. J. Surg. 45: 459-464, Sept. 1939.

*(15)* Allen, F. M.: Experiments concerning ligation and refrigeration in relation to local intoxication and infection. Surg., Gynec. & Obst. 68: 1047-1051, June 1939.

optimum temperature for rewarming frostbitten tissue. Finneran and Shumacker *(9)* determined quantitatively the effect of various rewarming temperatures on the extent of necrosis of mouse tails frozen at -15° C. for 5 seconds. Of the three temperatures investigated for rewarming (38°, 42°, and 50° C.), 42° C. gave the best results. The good results obtained by several investigators *(6, 8, 9)*, as well as ourselves, by rewarming at 42° C., are at variance with the conclusions of Arev *(5)*, who has emphasized that the temperature of the rewarming bath must not be higher than body temperature. He believed the overheating of tissues with higher bath temperatures to be deleterious.

## CONCLUSIONS

Rapid thawing of frozen legs in water at 42° C. for 5 to 8 minutes almost entirely prevented cutaneous necrosis after exposure to -12° and -15° C. for 30 minutes. Spontaneous rewarming in air at room temperature after these two standard injuries, in these and previous experiments, resulted in superficial necrosis in 20 and 90 percent of cases, respectively. The extent of muscular necrosis was definitely decreased by rapid thawing, but the results were not so striking as in the case of cutaneous necrosis. Prolonged rewarming with water at 42° C. up to 1 hour gave in all cases the same beneficial influence as rapid thawing for only 5 to 8 minutes. Animals with rapidly rewarmed legs exhibited a better general appearance than animals left to spontaneous rewarming and preserved better function of the injured limbs.

# Epidemic Typhus Vaccine

## Antibody Response to a Single Dose Among Persons Previously Vaccinated

Ross L. Gauld, *M. D., Dr. P. H.* (1)

Kenneth Goodner, *Ph. D.* (2)

ALL personnel in the Armed Forces of the United States are vaccinated against epidemic typhus fever before proceeding to assignments overseas. The initial vaccination consists of a series of 2 doses of vaccine given from 7 to 10 days apart and thereafter single booster injections are given each year, generally at the commencement of the typhus season. With this schedule it is possible to maintain a relatively high antibody level among those vaccinated (3) but the interval which may be allowed to elapse between booster doses and still evoke a satisfactory response has not been determined. Our purpose in this article is to present data summarizing the findings obtained when volunteers were given a single dose of epidemic typhus vaccine from 3 to 5 years after their last previous dose. The history of these volunteers with respect to typhus vaccination is similar to that of the millions of Americans who served overseas in the Armed Forces in World War II.

### MATERIAL AND METHODS

*Vaccine.*—A commercial vaccine (Lederle L-2124-1043A) was obtained through regular Army supply channels. This vaccine had passed the standard National Institutes of Health assay test before release to the Army. The bottle carried the expiration date of 15 May 1950 and was used in December 1949. At the time this vaccine was used it titrated 1:16 against 4 units of serum in a direct complement-fixation test. This test was used as an abbreviated method for a rapid single check of the presence of typhus complement-fixing antigen. Most commercial lots of typhus vaccine fix complement in this general range.

(1) Department of Virus and Rickettsial Diseases, Army Medical Service Graduate School, Army Medical Center, Washington, D. C.

(2) Department of Bacteriology and Immunology, Jefferson Medical College of Philadelphia.

(3) Topping, N. H.; Bengtson, I. A.; Henderson, R. G.; Shepard, C. C.; and Shear, M. J.: Studies of Typhus Fever. From the Division of Infectious Diseases, National Institute of Health. Federal Security Agency, United States Public Health Service, National Institute of Health Bulletin No. 183, 1945. pp. 65-86.

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*Volunteers.*—Fifty-five students at The Jefferson Medical College of Philadelphia volunteered to receive a single dose of the vaccine. All of these men were veterans who had served in the Armed Forces during World War II and had not received typhus vaccine since their separation from the services. The military or naval immunization records of all volunteers were obtained. The intervals elapsing between the last dose of typhus vaccine while in the Armed Forces and the single booster injection given in this study are summarized in table 1.

TABLE 1.—*Interval between last dose of vaccine and booster injection*

| *Interval* | *Number of volunteers* |
|---|---|
| 5-6 years | 15 |
| 4-5 years | 25 |
| 3-4 years | 11 |
| 2 years 10 months | 1 |
| Unknown, but over 4 years | 3 |

*Procedure.*—Two days after a prevaccination bleeding, the volunteers were each given a single 1 ml. dose of epidemic typhus vaccine subcutaneously. Following this injection all subjects reported soreness at the site of inoculation and 14 had additional symptoms. These reactions, however, did not appear to be more severe than those usually encountered with epidemic typhus vaccine. Postvaccinal bleedings were made on all volunteers from 38 to 40 days following the vaccination. The serums from both the pre- and post-vaccinal bleedings were refrigerated and sent by courier to the Department of Virus and Rickettsial Diseases, Army Medical Service Graduate School for laboratory tests. Complement-fixation tests for epidemic typhus were performed on all specimens obtained, care being taken to test the paired serums of each person in the same test. In addition, rickettsial agglutination and neutralization tests were made on the serums of a small group of selected subjects. The technics employed in the various tests were those routinely used at the Army Medical Service Graduate School (4).

## FINDINGS

*Complement-fixing antibodies.*—The results of the complement-fixation tests for epidemic typhus made on paired serums collected before and after the booster dose of vaccine are summarized in table 2. Of the 55 prevaccination serums, only 5 had a complement-fixation titer of 1:8 or better and 35 were entirely negative at the lowest dilution (1:2) tested. Although these subjects had little, if any, circulating antibody before receiving the vaccine, they responded well to the single booster dose. Serums collected from 38 to 40 days postvaccination showed at least a fourfold rise over the prevaccination titer in all but 2 subjects. The serum of one of these (No. 45) fixed complement at

(4) Plotz, H.; Bennett, B. L.; Wertman, K.; Snyder, M. J.; and Gauld, R. L.: Serological pattern in typhus fever; I. epidemic. Am. J. Hyg. 47: 150-165, Mar. 1948.

TABLE 2.—*Antibody response of 55 volunteers to a single dose of epidemic typhus vaccine*

| Volunteer | Number of booster doses of vaccine* | Interval since last dose (Years and months) | | Epidemic typhus complement-fixation titer | |
|---|---|---|---|---|---|
| | | | | Pre-vaccination | Post-vaccination |
| 1 | 3 | 5 | 9 | Neg. | 1:64 |
| 2 | 1 | 5 | 8 | Neg. | 1:64 |
| 3 | 1 | 5 | 7 | Neg. | 1:32 |
| 4 | 1 | 5 | 7 | 1:16 | 1:64 |
| 5 | 1 | 5 | 4 | Neg. | 1:32 |
| 6 | 1 | 5 | 4 | Neg. | 1:128 |
| 7 | 0 | 5 | 3 | Neg. | 1:64 |
| 8 | 0 | 5 | 2 | Neg. | 1:64 |
| 9 | 1 | 5 | 2 | Neg. | 1:128 |
| 10 | 2 | 5 | 2 | 1:2 | 1:128 |
| 11 | 0 | 5 | 1 | Neg. | 1:64 |
| 12 | 0 | 5 | 1 | Neg. | 1:128 |
| 13 | 2 | 5 | 0 | Neg. | 1:128 |
| 14 | 2 | 5 | 0 | 1:2 | 1:128 |
| 15 | 0 | 5 | 0 | Neg. | 1:128 |
| 16 | 1 | 4 | 11 | 1:4 | 1:32 |
| 17 | 2 | 4 | 11 | 1:8 | 1:128 |
| 18 | 0 | 4 | 11 | 1:4 | 1:64 |
| 19 | 1 | 4 | 9 | Neg. | 1:32 |
| 20 | 1 | 4 | 9 | Neg. | 1:16 |
| 21 | 2 | 4 | 8 | Neg. | 1:16 |
| 22 | 1 | 4 | 7 | Neg. | 1:64 |
| 23 | 1 | 4 | 7 | 1:2 | 1:256 |
| 24 | 2 | 4 | 5 | 1:8 | 1:32 |
| 25 | 1 | 4 | 4 | 1:2 | 1:128 |
| 26 | 1 | 4 | 4 | Neg. | 1:16 |
| 27 | 0 | 4 | 4 | Neg. | 1:128 |
| 28 | 0 | 4 | 3 | Neg. | 1:16 |
| 29 | 1 | 4 | 3 | Neg. | 1:16 |
| 30 | 0 | 4 | 3 | Neg. | 1:128 |
| 31 | 1 | 4 | 3 | 1:8 | 1:32 |
| 32 | 2 | 4 | 2 | 1:8 | 1:16 |
| 33 | 1 | 4 | 2 | 1:4 | 1:64 |
| 34 | 3 | 4 | 1 | Neg. | 1:16 |
| 35 | 3 | 4 | 1 | 1:4 | 1:32 |
| 36 | 1 | 4 | 0 | Neg. | 1:64 |
| 37 | 0 | 4 | 0 | Neg. | 1:128 |
| 38 | 4 | 4 | 0 | Neg. | 1:64 |
| 39 | 2 | 4 | 0 | 1:2 | 1:64 |
| 40 | 2 | 4 | 0 | 1:2 | 1:64 |
| 41 | 2 | 3 | 11 | Neg. | 1:16 |
| 42 | 3 | 3 | 10 | Neg. | 1:32 |
| 43 | 1 | 3 | 9 | Neg. | 1:16 |
| 44 | 3 | 3 | 9 | 1:2 | 1:32 |
| 45 | 3 | 3 | 9 | 1:64 | 1:64 |
| 46 | 2 | 3 | 8 | Neg. | 1:16 |
| 47 | 2 | 3 | 7 | Neg. | 1:16 |
| 48 | 0 | 3 | 7 | Neg. | 1:32 |
| 49 | 3 | 3 | 5 | 1:4 | 1:64 |
| 50 | 1 | 3 | 4 | Neg. | 1:128 |
| 51 | 0 | 3 | 3 | Neg. | 1:64 |
| 52 | 0 | 2 | 10 | Neg. | 1:128 |
| 53 | ? | 4 | ? | 1:2 | 1:16 |
| 54 | ? | 4 | ? | Neg. | 1:4 |
| 55 | ? | 4 | ? | 1:2 | 1:32 |

*In addition to initial series.

1:64 before vaccination and his postvaccination specimen titrated at the same level. The other (No. 32) showed a titer of 1:8 at the time of the prevaccination bleeding and showed only a 1-tube rise to 1:16 after vaccination. The vast majority of the subjects had a good response to the booster, and 47 of the 55 had at least a 4-tube (sixteenfold) increase in titer while in 11 the rise was 7 tubes or more.

*Neutralizing and agglutinating antibody.*—In a small group of subjects the antibody reaction was also measured by means of neutralization and rickettsial agglutination tests. The immunologic responses of these men as shown by the different technics are summarized in table 3. The results obtained by the 3 tests employed are in good agreement with respect to the antibody rise. Those subjects who had satisfactory antibody rises when the complement-fixation test was employed also had satisfactory rises when the agglutination and neutralization tests were used. At the same time, volunteer No. 45, who had no rise in complement-fixing antibody showed only a twofold rise by the neutralization technic and a fourfold rise (1:80 to 1:320) in agglutinating antibody. The tests with specific murine typhus antigen indicate that the rise in antibody to epidemic typhus was also accompanied by some rise in murine typhus antibody.

TABLE 3.—*Antibody response of 7 volunteers to a booster dose given from 3 to 5 years after last injection of epidemic typhus vaccine*

| Number | Complement fixation | | | | Rickettsial agglutination | | | | Neutralization | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Epidemic typhus | | Murine typhus | | Epidemic typhus | | Murine typhus | | Epidemic typhus | |
| | Before | After | Before | After | Before | After | Before | After | Before | After |
| 15 | Neg. | 1:128 | Neg. | 1:32 | 1:40 | 1:320 | Neg. | 1:80 | 1:4 | 1:512 |
| 18 | 1:4 | 1:64 | 1:4 | 1:8 | 1:40 | 1:160 | 1:20 | 1:40 | 1:8 | 1:256 |
| 23 | 1:2 | 1:256 | — | — | — | — | — | — | 1:4 | 1:1024 |
| 54 | Neg. | 1:4 | Neg. | Neg. | 1:20 | 1:160 | Neg. | 1:40 | Neg. | 1:32 |
| 45 | 1:64 | 1:64 | 1:8 | 1:16 | 1:80 | 1:320 | 1:20 | 1:80 | 1:128 | 1:256 |
| 37 | Neg. | 1:128 | 1:2 | 1:16 | 1:40 | 1:160 | Neg. | 1:80 | 1:4 | 1:512 |
| 6 | Neg. | 1:128 | Neg. | 1:64 | 1:40 | 1:320 | 1:20 | 1:160 | 1:4 | 1:512 |

## DISCUSSION

In this study we did not attempt to define the frequency with which booster doses of epidemic typhus vaccine must be given in order to maintain a satisfactory antibody level among those potentially exposed to infection. Furthermore, we did not consider the more theoretical question of whether it is necessary to maintain measurable antibody levels in order to obtain a prompt anamnestic response. The results of the tests of the prevaccination serums indicate that these subjects possessed little circulating antibody at that time. Thus, from 3 to 5 years is too long an interval between booster doses of vaccine if it

is desired to keep the antibody at high levels. On the other hand, the response of these persons to a single dose of vaccine was excellent and compares favorably with the response of those who received a booster injection 9 months following the initial series (3). The post-vaccination serums in 54 of the 55 subjects showed a satisfactory antibody level, indicating that once primary vaccination has been accomplished satisfactory antibody levels can be restored by the administration of a single dose of vaccine even if 4 or 5 years have elapsed since the last previous antigenic stimulation. The degree of response appears to be unrelated to the time elapsed since the last vaccination and to the number of doses previously received. The serums of those who previously had received only the initial series of 2 doses titrated at the same levels as those who had been given 2 or 3 booster doses. There was some evidence that those subjects in whose pre-vaccination serum antibody could not be demonstrated by the complement-fixation technic were more prone to systemic reaction when vaccinated. The number of these was, however, too small for conclusive evaluation.

## CONCLUSION

If it should become necessary to recall veterans into service, the level of their antibody against epidemic typhus could be satisfactorily restored by the administration of a single dose of epidemic typhus vaccine.

THE WHITE HOUSE
WASHINGTON

May 8, 1951

Dear Admiral McIntire:

For the third time in thirty-four years, the life of this Nation is threatened by an aggressor. As our country makes the greatest defense effort any nation has been forced to attempt, the problem of manpower becomes basic. Manpower shortages, already felt in some quarters, will become increasingly acute as we speed our defense effort.

In our Nation's physically handicapped lies a vast reservoir of relatively untapped skills. These skills, properly utilized, constitute a mighty bulwark against the present threat of manpower shortages. They must not be overlooked in our preparedness program. Qualified handicapped workers not now employed should be employed. Those not trained should be trained, screened for maximum usefulness and given the opportunity to contribute their skills and abilities.

The Congress has designated the first week in each October as National Employ the Physically Handicapped Week, a time in which to call special attention to the need for increased employment of the handicapped. This need has never been more urgent.

As President of the United States, I call upon every American to provide greater opportunities for the employment and rehabilitation of the handicapped; not just during the observance of National Employ the Physically Handicapped Week, but during fifty-two weeks of the year. I earnestly ask that all informational and educational means be utilized to obtain the widest possible public understanding of this national program.

The manpower challenge that we face can be met. It must be met, if we are to survive as a Nation and preserve the peace of the world.

Very sincerely yours,

Harry Truman

Vice Admiral Ross T. McIntire
(MC), USN, Retd.,
Chairman,
The President's Committee on
National Employ the Physically
Handicapped Week,
U. S. Department of Labor,
Washington, D. C.

# Medical Problems of an Underwater Demolition Team[1]

Charles L. Waite, *Lieutenant, MC, U. S. N. R.*

AS IN all highly specialized naval activities, the officers and men assigned to an underwater demolition team face certain occupational hazards which are peculiar to their group. Our purpose in this article is to describe the medical aspects of these hazards and to suggest means for their prevention and treatment. The tactical function of an underwater demolition team is twofold: (1) the preassault phase in which the team supports an armed landing force by reconnaissance of an enemy beach or harbor, followed by destruction of natural and artificial obstacles which might impede the landing, and (2) a postassault phase in which further clearing by demolition is carried out to facilitate the landing. In carrying out these activities the assigned personnel are required to spend many hours in and under the water, doing heavy work under varying conditions of mental stress and are exposed to physical injury from pressure, exposure, underwater life and obstacles, and enemy action.

## HAZARDS FROM PRESSURE

*Squeeze.* This accident involves the face of the underwater swimmer and is produced only when a face mask or goggles are being used and the air pressure within the face mask suddenly drops below that of the ambient pressure exerted by the water. This situation may result from the sudden failure of the air supply or from a sudden drop in depth by the swimmer, as falling from a reef or ledge, without an increase in the air supply to the mask. The relative negative pressure thus produced within the mask exerts its force on the eyes and skin of the face and, if severe enough, on the mucosa of the upper respiratory tract. A mild squeeze will cause tiny punctate hemorrhages to appear in the scleras, and a more severe squeeze results in periorbital and facial edema and ecchymosis, causing the eye and surrounding tissue to bulge outwardly. The severe form of this condition may result in death

(1) Experimental Diving Unit, U. S. Naval Gun Factory, Washington, D. C.

or blindness and requires expert medical care. Another type of squeeze which affects the chest may occur if a "skin dive" (holding the breath) is made to a depth which is sufficient to compress the air in the lungs to a volume smaller than the residual air of the diver.

*Aero-otitis media* is caused by inequality in the pressure between the middle ear and the external ear, which may result in hemorrhage and/or rupture of the ear drum. The eustachian tube must be patent for pressure equalization. The usual cause for blockage of this tube is an abnormal aggregation or edema of the lymphoid tissue about the nasopharyngeal end of the tube. More commonly, an upper respiratory infection and, more rarely, a congenital abnormality may be the direct cause of the enlarged lymphoid tissue. The stretch placed on the drum results in a severe pain which usually prevents the swimmer from attaining a depth greater than 10 feet. When hemorrhage does occur, the treatment is symptomatic and supportive and the ear must be kept absolutely dry until the hemorrhage has been absorbed. If the drum is ruptured, steps should be taken to prevent secondary infection. If the cause of the inability to equalize pressure in the middle ear is an abnormal amount of lymphoid tissue blocking the eustachian tube, a series of radium treatments applied through the nasopharynx will usually, clear it up. Every candidate for this type of training is given a test of 50 pounds of air pressure in a recompression chamber in order to determine his ability to equalize pressure.

*Compressed air illness*, commonly called "bends" or caisson disease, results from inadequate decompression following exposure to increased atmospheric pressure. Although the major portion of the swimming engaged in by demolition team personnel is on the surface or at shallow depths, the possibility of compressed air illness should always be kept in mind. Two cases of compressed air illness which resulted from dives made at depths of less than 34 feet and of less than 45 minutes' duration have recently been reported *(2)*. Therefore, compressed air illness should be considered in treating anyone doing moderate to heavy work under increased air pressures for any length of time. The most important point to remember is to treat all suspected cases according to the Standard U. S. Navy Treatment Tables as shown in chart 1.

*Air embolism* results from tearing of the lung tissue and the admission of a large quantity of air into the blood stream. The ensuing embolism can cause asphyxia, convulsions and coma, or paralysis and death. Personnel engaged in underwater demolition expose themselves to the possibility of air embolism when it becomes necessary to discard the face mask of an underwater breathing apparatus, either because of flooding or mechanical failure, and rise to the surface in the manner in which free escape is performed. If the air in the lungs is not

*(2)* Welham, W., and Waite, C. L.: Decompression sickness; report of two unusual cases. Armed Forces Med. J. 2: 1201-1205, Aug. 1951.

CHART 1. *Treatment of caisson disease and air embolism*

| Stops | | Bends—pain only | | | | Serious symptoms | |
|---|---|---|---|---|---|---|---|
| Rate of *descent*—25 ft. per min.<br>Rate of *ascent*—1 minute between stops. | | Pain relieved at depths *less than* 66 ft.<br>Use table 1-A if oxygen is not available | | Pain relieved at depths *greater than* 66 ft.<br>Use table 2-A if oxygen is not available.<br>If pain does not improve within 30 min. at 165 ft. the case is probably *not* bends. Decompress on table 2 or 2-A. | | Serious symptoms include any one of the following.<br>1. Unconsciousness.<br>2. Convulsions.<br>3. Weakness or inability to use arms or legs.<br>4. Any visual disturbances.<br>5. Dizziness.<br>6. Loss of speech or hearing.<br>7. Severe shortness of breath or chokes. | |
| | | | | | | Symptoms *relieved* within 30 min. at 165 ft.<br>Use table 3 | Symptoms not *relieved* within 30 min. at 165 ft.<br>Use table 4 |
| Lb. | Ft. | Table 1 | Table 1-A | Table 2 | Table 2-A | Table 3 | Table 4 |
| 73.4 | 165 | ——— | ——— | 30 (air) | 30 (air) | 30 (air) | 30 to 120 (air) |
| 62.3 | 140 | ——— | ——— | 12 (air) | 12 (air) | 12 (air) | 30 (air) |
| 53.4 | 120 | ——— | ——— | 12 (air) | 12 (air) | 12 (air) | 30 (air) |
| 44.5 | 100 | 30 (air) | 30 (air) | 12 (air) | 12 (air) | 12 (air) | 30 (air) |
| 35.6 | 80 | 12 (air) | 12 (air) | 12 (air) | 12 (air) | 12 (air) | 30 (air) |
| 26.7 | 60 | 30 ($O_2$)* | 30 (air) | 30 ($O_2$)* | 30 (air) | 30 ($O_2$* or air) | 6 hr. (air) |
| 22.3 | 50 | 30 ($O_2$)* | 30 (air) | 30 ($O_2$)* | 30 (air) | 30 ($O_2$* or air) | 6 hr. (air) |
| 17.8 | 40 | 30 ($O_2$) | 30 (air) | 30 ($O_2$) | 30 (air) | 30 ($O_2$ or air) | 6 hr. (air) |
| 13.4 | 30 | | 60 (air) | 60 ($O_2$) | 2 hr. (air) | 12 hr. (air) | First 11 hr. (air) Then 1 hr. ($O_2$ or air) |
| 8.9 | 20 | 5 ($O_2$) | 60 (air) | | 2 hr. (air) | 2 hr. (air) | First 1 hr. (air) Then 1 hr. ($O_2$ or air) |
| 4.5 | 10 | | 2 hr. (air) | 5 ($O_2$) | 4 hr. (air) | 2 hr. (air) | First 1 hr. (air) Then 1 hr. ($O_2$ or air) |
| Surface | | | 1 min. (air) | | 1 min. (air) | 1 min. (air) | 1 min. ($O_2$) |

Time at all stops in minutes unless otherwise indicated.

If symptoms return while breathing air *during* treatment with any of the above tables, recompress to depth of relief but never less than a depth of 30 ft. and then complete decompression from this depth according to table 4

*If dizziness, nausea, muscular twitching or blurring of vision occurs while breathing oxygen, remove mask and proceed as follows: (a) if using table 1, complete remaining stops of table 1-A; (b) if using table 2, complete remaining stops of table 2-A; (c) if using table 3, complete remaining stops of table 3 breathing air. At the discretion of the *medical officer*, oxygen breathing may be resumed at the 40 and 30 foot stops for a total of 90 minutes if using table 1 or 3 and 150 minutes if using table 2.

RECURRENCES:—Should symptoms *recur following* treatment with any of the above tables, recompress the diver to a depth giving relief. If relief occurs at depths *less than* 30 feet take diver to 30 feet and decompress from 30 foot stop to surface according to table 3. If relief occurs *deeper than* 30 feet, remain at the depth of relief for 30 minutes and then complete remaining stops of table 3 using air throughout.

permitted to escape rapidly enough or in sufficient quantity during the ascent, the resulting expansion causes tearing of the lung tissue with resultant embolism. Air embolism is always treated with recompression, and the faster this is instituted, the better. Proper training and a knowledge of the condition is the best method of preventing air embolism. Under combat conditions proper treatment will not be available and once an air embolism has occurred the man so affected will be unable to perform his duties.

*Oxygen poisoning* is a serious condition, the exact mechanism of which is not known. If 100 percent oxygen is breathed at depths greater than 60 feet while resting or at depths over 30 feet while working, oxygen poisoning may result. The early or warning symptoms are lip-twitching, nausea, irritability, nerve pain similar to that of an electric shock, and visual and auditory aura. Convulsions and coma may ensue rapidly either after the warning symptoms or without their presence. Following the convulsions and coma a state of mental confusion and, at times, a severe restlessness that borders on mania usually results. Oxygen poisoning is treated by the prompt cessation of the dive and the inhalation of fresh air. Prevention of bodily injury and drowning must be guarded against in the presence of convulsions. Biting or swallowing of the tongue may also occur. Limitation of the depth of the swimmer when pure oxygen is being used is the only sure method of prevention.

## HAZARDS FROM USING UNDERWATER BREATHING APPARATUS

*Anoxia and carbon dioxide poisoning* occur as the result of mechanical failure of an underwater breathing apparatus or because of a mistake in operation made by the swimmer. Mechanical failure is usually caused by a severe leak in a supply line, a faulty valve, or the use of inactive carbon dioxide absorbent. The anoxia that occurs is of the anoxic type and is sudden in onset. Carbon dioxide accumulation, on the other hand, gives the swimmer some warning symptoms such as shortness of breath, headache, nausea, dizziness, and weakness. The fogging of the faceplate is not a good indication of carbon dioxide retention because this occurs frequently when the swimmer is receiving an ample oxygen supply. The treatment of both conditions is the same: termination of the dive and plenty of fresh air. Oxygen, stimulants, and artificial respiration are required in the more serious cases, especially when complicated by partial drowning.

*Drowning* usually occurs as a complication of anoxia or carbon dioxide poisoning rather than as an entity. An injury sustained while working or swimming in heavy surf or severe muscular cramps may both disable a swimmer. Prompt treatment with artificial respiration and the administration of stimulants is lifesaving. The submersion case is aided in his recovery by the use of penicillin prophylactically and small doses of serum albumin to absorb any water remaining in the lungs.

## INJURIES FROM ENEMY ACTION

### *Blast Injuries*

Probably no other group in the Navy is so routinely exposed to the hazards of an underwater explosion as are the personnel of an underwater demolition team. Severe injury and death can result from the effects of a blast following a nearby air or underwater explosion. The factors which determine the degree of injury sustained by personnel in the water are (1) proximity to the source of the blast, (2) size and character of the explosive, (3) the medium through which the force is transmitted, (4) the degree of submersion of the diver, and (5) the protection worn by the diver. All these factors are related in the production of the final effect of an explosion on a swimmer.

*Proximity and size of the explosion* are considered together because the total force exerted by a blast wave on a diver can be calculated from a formula which involves both. The pressure in pounds per square inch *(P)* exerted by an underwater explosion of tetryl or TNT is expressed by the formula $P = \frac{13000\ \sqrt[3]{W}}{d}$ in which $W$ is the weight of the explosive and $d$ is the distance of the explosion from the diver *(3)*. A sample calculation shows that a 600-lb. charge at a distance of 50 feet exerts a pressure of 2,180 lb. per square inch. A pressure of 500 lb. is sufficient to cause injury to the lungs and intestinal tract; therefore, one exerting 2,180 lb. per square inch would invariably be fatal. There are two phases of an underwater blast: the compression wave which is the destructive factor and the disturbance caused by the expanding gases liberated by the explosion. This second wave has no destructive power. Another phenomenon observed in an underwater blast is the "shredding effect." When a compression wave reaches the surface of the water and exceeds a pressure of 500 lb. per square inch, the surface of the water at a particular point will be literally shredded into narrow strips and blown upward as fingerlike projections of water. The solid organs (the liver, kidneys, and spleen) will be undamaged, but the organs that contain gas (the lungs and intestinal tract) will be shredded and perforated. Injury occurs by this mechanism, not by forcing of air or water down the throat or up the rectum. Therefore, the practice of covering the rectum in anticipation of an underwater explosion is useless.

*Character of the explosion and the transmitting media.* Different explosives have different velocities of detonation or brisance. A highly brisant explosive produces its maximum pressure effect almost instantaneously, but this effect diminishes as rapidly as it was produced. An explosive with a lesser brisance will develop its maximum pressure more slowly, last longer, and therefore be more effective at a longer range, provided the medium through which it is transmitted is re-

*(3)* Bureau of Naval Personnel: Submarine Medicine Practice (title III of Military-Medical Operations Courses), NavPers 10838, March 1949. pp. 49-57.

latively incompressible. When water is the transmitting medium, explosives of low brisance have a greater effective range for a longer period of time and thus cause a greater amount of injury. For the same amount of charge, airborne blast pressures are of much less force than water-borne pressures.

*Degree of submersion.* In the event of an underwater explosion, the smaller the portion of the body submerged, the better. If the head, chest, and abdomen are below the surface all three could sustain sufficient damage to be fatal. A person who is swimming on his back or side rather than on his abdomen has a better chance to survive. The shredding effect is minimized because of the greater thickness of tissue of the back. The best evasive tactics have to be decided for each operation. If air or surface blasts are anticipated, the best evasive tactics would be to swim deep. If underwater blasts are expected, then surface swimming on the back or side would be best. Protective clothing made from foam rubber or kapok have been shown to offer the maximum amount of protection for the minimum amount of weight. Future designing of swimming suits should include a protective lining of either of these materials around the chest and abdomen.

*Description of blast injuries.* Injury to the brain and central nervous system may occur if the head is submerged at the time of an underwater explosion. The chest and particularly the abdomen are the more common sites of injuries. Bruising and laceration of the skin are never seen following a submerged blast, even though the underlying organs may be severely damaged. In severe blast injuries, laceration of the lungs and pleura will occur and extensive hemorrhage is present throughout the bronchi, bronchioles, and alveoli. Intestinal perforation produces all the symptoms of an acute surgical condition of the abdomen. Prompt surgical repair and the use of antibiotics are important. The only skeletal injury ever reported from an underwater blast is that of a compression fracture of one or more of the lumbar vertebras (3).

*Nuclear Radiation Hazards*

An area of water can become radiologically contaminated following an air, surface, or underwater burst of an atomic bomb. Contamination of water following an air burst is caused by the "fall-out" of radioactive particles, but most of the contamination following a surface or underwater burst is caused by direct radiation of the water. Because an enemy may render a beach radioactive by sowing radioactive material (fission products) at various landing points, personnel engaged in underwater demolition may encounter radiation hazards on land as well as in the water. Because the total roentgen dosage decreases rapidly, water is not usually as great a hazard as radioactive land. The factors which are responsible for this rapid decrease are natural decay, rapid dispersion of the total amount of radioactivity through a large area, and

the natural dilution of the water by currents and tides (*4*). This last factor will vary with the geographic location. Most of the radioactive particles in water will settle to the bottom in from 1 to 2 weeks following an underwater burst. In such a situation a swimmer should stay away from the bottom. The fact that radioactivity can be spread by marine life presents another problem. Seaweed, algae, and plankton absorb the radioactive salts from the water. These plants in turn are eaten by fish and other forms of marine life and thus a large area could be contaminated even though it was not exposed to the initial source of radiation. Preliminary reconnaissance of an area with radiation monitoring instruments and the use of small dosimeters by the personnel are the only satisfactory preventive measures which can be offered at this time.

## EXPOSURE HAZARDS

*Water temperatures* below 60°F. will seriously limit the time that can be spent in the water as well as the operating effectiveness of the personnel. Chilling and fatigue may predispose to infections of the upper respiratory tract. Colds, sinusitis, and middle ear infections are common among personnel engaged in underwater demolition and at times are definitely prolonged or made worse by further swimming. This is true whether the water is cold or warm. It should be a rule, particularly during training periods, that personnel afflicted with upper respiratory infections stay out of the water until well on the way to recovery because the time thus lost is less than that lost because of a complicated infection or a relapse brought on by attempts to shorten the convalescence. This method is recommended to keep the maximum number of men in operational readiness for the greatest number of days. Following exposure to a chilling environment, hot soup or coffee are excellent body warming measures and may aid in preventing a respiratory infection.

*Sunburn* may result from uncontrolled exposure to the sun. The health and efficiency of personnel are seriously affected by this. If the time is available, a daily schedule of gradual exposure should be arranged. An hour a day is used at first with a gradual increase each day. If time is lacking for the gradual method, protective clothing and sunburn protective ointment should be used, particularly on the shoulders, back, nose, and face. Zinc oxide can be used in place of the standard protective ointment. The present protective ointment should be modified for use by the demolition teams because the brilliant white color is a detection risk and prevents its use in actual operations.

## MISCELLANEOUS UNDERWATER HAZARDS

*Fungus infections* are common among personnel engaged in underwater demolition, particularly those operating in a warm, moist climate.

(*4*) The U. S. Atomic Energy Commission and The U. S. Department of Defense: The Effects of Atomic Weapons. Prepared under the direction of The Los Alamos Scientific Laboratory, Los Alamos, New M., June 1950. p. 282.

The ears, hands, feet and groin are the most common sites affected. Otomycosis is a subacute or chronic and recurrent mycotic infection characterized by an exudate. The patients complain chiefly of pruritis and pain, especially at night. Hearing is frequently impaired, and in the subacute phase the external auditory meatus may be swollen shut, red, and weeping and the entire ear may be exquisitely tender to palpation. The chronically infected ear shows flaking, crusting and a discharge composed of cerumen, dried skin, and serum. The drum frequently loses its light reflex and is a dull white. A superimposed secondary bacterial infection is not uncommon. The treatment of the acute phase should be of a soothing nature: compresses are applied to reduce edema, the external canal is irrigated with a solution of hydrogen peroxide and sodium bicarbonate, and wicks saturated with Burow's solution are repeatedly placed in the canal. Irritants such as phenol and salicylic acid should be avoided. When the infection has subsided the affected parts should be painted with 1 percent gentian violet *(5)*.

The rate of recurrence is high and when the infection has begun, even though it appears to have cleared with treatment, further exposure to water causes it to flare up again. On a recent training cruise with an underwater demolition team in a semitropical climate, a program to prevent fungus of the ears was instituted. After every swim the ears were swabbed dry and a fungicidal powder (undecylenic acid and zinc undecylenate) was blown into the external auditory meatus with an atomizer. In a 6-week period, during which the personnel involved were in the water almost every day, there were no cases of fungus infection of the ears as compared with the high incidence observed on previous trips to the same area. Fungus infection of the feet and groin are a less serious threat to underwater demolition teams. The usual precautions of thorough drying of the body, frequent changing of socks, and the avoidance of wearing a wet bathing suit are the only preventive measures required. Fungus infection of the feet in the acute exudative phase should be treated with a 1:10,000 solution of potassium permanganate and later with half strength whitfield's ointment. Fungus infection of the groin responds to daily treatment with Castellani's paint.

*Acute bacterial infection of the external ear* is common among underwater demolition teams. This was first described by Mitchell *(6)* as an acute inflammatory process involving the external ear and caused by streptococci. It is at times indistinguishable from the early phase of otomyocosis. If seen early enough a small furuncle may be found, but in the later stages the edema and tenderness make thorough examination of the ear impossible. There is no attendant pruritus as is found in otomycosis, the ear drum is normal in appearance, if it can be visual-

*(5)* Ormsby, O. S., and Montgomery, H.: Diseases of the Skin. 7th edition (revised). Lea and Febiger, Philadelphia, Pa., 1948. p. 1092.

*(6)* Mitchell, J. H.: Streptococcic dermatoses of the ears. J. A. M. A. 108: 361-366, Jan. 30, 1937.

ized, and there is no discharge. Treatment consists of hot compresses to reduce the edema and either penicillin or sulfadiadine for the infection. Most cases will clear up completely in 2 or 3 days if the patient stays out of the water.

*Injuries from underwater life* may be encountered. Any laceration sustained in the water, particularly in a warm, moist climate, should be treated as an infected wound. Coral is the most frequent offender because team personnel are frequently required to engage in operations in and around coral reefs. The primary reaction to a coral cut, sometimes called "coral poisoning," is characterized by the appearance of wheals, reddening and intense itching in and around the wound. This is an allergic reaction of the skin to a toxin liberated by the nematocysts or "sting cells" of the tiny polyps that form the coral. Antihistaminic drugs given orally or applied locally to the site afford immediate relief. A coral cut or abrasion left untreated will show signs of advanced inflammation within 24 hours. The coral found in some geographic locations is more "poisonous" than that found in others. First aid in the form of simple cleansing and the application of an antiseptic will prevent infection in most cases, but penicillin or sulfadiazine may be required for the more seriously infected wounds.

Sea urchins *(Strongylocentrotus drobachiensis)* are echinoderms with long sharp movable spines radiating out in all directions except at the point of attachment. They have a predisposition for beaches and shallow water and present a definite hazard to swimmers. It is not uncommon for a swimmer to come away from an encounter with a sea urchin with 30 or more spines in his skin. The spines, which vary from about 2 to 15 cm. in length, have hundreds of microscopic barbs that make extraction difficult. They are brittle and crumble when an attempt is made to remove them with forceps. The larger spines are easier to remove than the smaller ones. Broken spines that are buried deeply in the skin may be left alone for they will be absorbed. After the removal of as many spines as possible, the area should be cleaned with an antiseptic and cushioned with a large dressing. Penicillin and sulfadiazine should be administered prophylactically because the spines carry bacteria deep into the body. As in coral injuries, the wound should be kept absolutely dry. Rubber-soled canvas shoes protect the feet from both sea urchins and coral.

Sea nettles and Portuguese-men-of-war produce a dermatitis which is characterized by erythematous linear lesions which become urticarial, bullous, and at times hemorrhagic. The sharp stinging pain and the pruritus produced vary in severity and duration depending on the total time in contact with the nettle or its detached tentacles. Klein and Bradshaw *(7)* stated that no attempt should be made to remove the clinging tentacles with the bare hands as this will result in spreading the lesions to other parts. First aid consists of removing the tentacles

*(7)* Klein, W. E., and Bradshaw, R. H.: Portuguese man-of-war sting. Armed Forces Med. J. 2: 509-512, Mar. 1951.

by picking them off with a towel or any other piece of cloth and washing the area with fresh water and the application of an analgesic ointment. The use of epinephrine or an antihistaminic drug will allay the pruritus and urticaria. A severe secondary reaction of rapid onset is sometimes seen following a nettle sting. Pallor, sweating, muscular cramps, faintness, shortness of breath, thready pulse, and a fall in blood pressure are indicative of anaphylactic shock and emergency treatment with epinephrine given intravenously or benadryl should be administered. If angioneurotic edema appears, the air passageways should be cleared, oxygen administered, and a tracheotomy performed if necessary. There have been no authenticated medical reports of death as a result of a Portuguese-man-of-war sting, although it may occur if complicated by anaphylactic shock.

## PSYCHOLOGIC ASPECTS AND THE SELECTION OF PERSONNEL

To give a man who swims a pair of swim fins and a face mask does not produce an underwater demolition team member. The physical hardships and mental strain make this duty suitable only for carefully selected personnel. As in the submarine service and with deep sea divers, the candidate must be a volunteer. A careful investigation of the factors of motivation should be made in order to screen out those who attempt to avoid certain duty because they dislike it. The candidate must also realize the type of duty for which he has volunteered. The reconnaissance work requires the candidate to possess above average intelligence, and to be resourceful and capable of working alone. He must be team-conscious, cooperative and fit in with the group. Claustrophobia, of which there is a high incidence among the candidates, may become evident during the first underwater experience or may not develop until after repeated exercises. To overcome this fear confidence in one's own ability and in the equipment is necessary. The candidate may frankly admit his claustrophobia. If he does, it is simple to eliminate him from the team, but when he fails to admit his fear, the problem becomes complicated. The first evidence may be a loss of working efficiency or psychosomatic complaints such as easy fatigue, shortness of breath, and numerous aches and pains. The medical officer must rule out actual illness before entertaining a psychosomatic diagnosis. Effective psychologic screening of personnel can only be accomplished by the personal interview technic. Written questionnaires can be answered in a fashion to determine that the candidate is psychologically fit whereas in an interview with the medical officer the questioning can be guided along lines which may reveal neuropsychiatric traits. At the same time an appraisal of the manner of response may be made.

# Needle Biopsy of the Liver

Otto A. Wurl, *Lieutenant Colonel, MC, U. S. A.* (1)

John H. Moyer, *M. D.* (2)

IN RECENT years interest in needle biopsy of the liver as a diagnostic adjunct to the clinical and laboratory examination of the patient with hepatic or suspected hepatic disease has been increasing. This interest has been caused in large part by the renewed impetus given this technic by Roholm and Iversen (3) and by Dible et al. (4) in the study of the pathology of epidemic and serum hepatitis. That this approach to a better understanding of liver disease is not new has been pointed out by Hoffbauer (5). The series of 81 biopsies herein reported thus represents but a small contribution to the gradually increasing number now being performed throughout the world.

Needle biopsy of the liver was begun at this hospital by one of us (J. H. M.) in late 1946. Originally the subcostal approach, first recommended by Baron (6) and subsequently used by Tripoli and Fader (7), was employed, using the "Vim"-Silverman needle. This technic was employed only in the presence of a definitely palpable liver, as advocated by Hoffbauer et al. (8). In early 1947, after study on cadavers, the intercostal approach was adopted. This change was prompted by a desire to avoid the hazard of perforating the gallbladder or other hollow viscera, and to extend the technic in the elucidation of liver disorders not accompanied by hepatomegaly. This intercostal technic has proved

(1) Brooke Army Hospital, Fort Sam Houston, Tex.

(2) Department of Medicine, Baylor University College of Medicine, Houston, Tex.

(3) Roholm, K., and Iversen, P.: Changes in liver in acute epidemic hepatitis (catarrhal jaundice) based on 38 aspiration biopsies. Acta path. et microbiol. Scandinav. 16: 427-442, 1939; abstr., Leberveränderungen bei akuter epidemischer Hepatitis. Verhandl. d. deutsch. Gesellsch. f. inn. Med., Kong. 51, pp. 359-361, 1939.

(4) Dible, J. H.; McMichael, J.; and Sherlock, S. P. V.: Pathology of acute hepatitis; aspiration biopsy studies of epidemic, arsenotherapy and serum jaundice. Lancet 2: 402-408, Oct. 2, 1943.

(5) Hoffbauer, F. W.: Needle biopsy of liver. J. A. M. A. 134: 666-670, June 21, 1947.

(6) Baron, E.: Aspiration for removal of biopsy material from liver; report of 35 cases. Arch. Int. Med. 63: 276-289, Feb. 1939.

(7) Tripoli, C. J., and Fader, D. E.: Differential diagnosis of certain diseases of liver by means of punch biopsy. Am. J. Clin. Path. 11: 516-527, June 1941.

(8) Hoffbauer, F. W.; Evans, G. T.; and Watson, C. J.: Cirrhosis of liver, with particular reference to correlation of composite liver function studies with liver biopsy. M. Clin. North America 29: 363-388, Mar. 1945.

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to be so satisfactory that the subcostal approach has been abandoned, even in the presence of gross liver enlargement.

## TECHNIC

The patient must be conscious, alert, and cooperative. The bleeding, clotting, and prothrombin times must be within normal range; a value of 25 seconds as compared to a control of 20 seconds is regarded as the upper limit for the prothrombin time. Blood typing and cross-matching are done. Preoperative medication consists of from 0.1 to 0.2 gram of pentobarbital sodium 1 hour before the procedure. The biopsy is performed with the patient in the supine position with his head supported by one pillow. He lies on the right side of the bed with his right arm extended over his head in order to widen the intercostal spaces. The site of insertion of the needle is chosen at the inferior margin of the costophrenic sinus, at the attachment of the diaphragm, in the anterior or midaxillary line. This site is ordinarily on a level with a point about 3 cm. below the xyphoid process of the stemum and in the eighth intercostal space. The desired site is that opposite the thickest part of the right lobe of the liver, above and lateral to the gallbladder. The skin is prepared with tincture of merthiolate. One percent procaine is liberally injected into the interspace, anesthetizing down to the parietal pleura. A 1/8-inch incision is made in the skin at the site of the injection of the biopsy needle. The patient is instructed to inspire deeply and exhale completely 4 or 5 times, finally holding the breath in complete expiration. The biopsy is then secured in the usual manner and the core of tissue is immediately placed in 10 percent formalin, Zenker's fluid, or Bouin's fluid. The securing of the tissue requires about 10 seconds from the time of insertion of the trocar until withdrawal of the two needles and specimen. Postoperative pain has been minimal and readily controlled by one or two doses of codeine. The patient is frequently observed for bleeding in the first 3 hours after the procedure; during this period he is cautioned to remain quietly in bed. For the next 21 hours he is permitted bathroom privileges only and after 24 hours there is no restriction of activity.

The possibility of hemorrhage from the liver incident to laceration because of fixation of the needle in the intercostal space has been mentioned *(6, 8)*. As a safeguard, the patient is instructed to hold his breath in expiration until completion of the procedure.

## CLINICAL MATERIAL

This report comprises 81 biopsies performed on 81 patients that were admitted to the wards of this hospital between November 1946 and November 1948. Seventy-nine of the patients were men and 2 were women. Their ages ranged from 18 to 76 years. For purposes of study these patients were categorized in 7 different groups by their clinical diagnoses: Group I, 31 with portal cirrhosis; Group II, 2 with acute hepatitis; Group III, 10 with chronic hepatitis; Group IV, 10 with hepatomegaly of undetermined cause; Group V, 5 with congestive hepatomegaly; Group VI, 7 with miscellaneous clinical diagnoses; and Group VII, 16

with no evidence of liver disease who served as controls. Tables 1 and 2 summarize the pertinent clinical and laboratory findings.

## USE OF TERMS

The adequacy of each patient's diet was determined insofar as possible. "Good" implies a generally well-balanced diet with respect to carbohydrate, protein, fat, vitamin, and mineral content. The regular ingestion of meat, milk, and eggs was particularly inquired about and the patient's eating habits were observed on the ward. "Fair" indicates a diet that was less than adequate, usually deficient in protein and calories. A diet frankly deficient both quantitatively and qualitatively was listed as "poor" and is typified by the diet of many patients with chronic alcoholism who habitually stop eating during bouts of drinking. Alcohol intake was listed as "mild" for the social drinker, and "moderate" for those falling between the social drinker and the chronic alcoholic. The degree of hepatomegaly and splenomegaly is expressed as the palpability of the liver in centimeters below the costal margin in full inspiration. Spider angiomata were frequently noted, but their occurrence was omitted from the clinical synopses.

Under "histopathologic diagnosis" (1) *portal cirrhosis* included those specimens which on microscopic section demonstrated definite derangement of normal lobular architecture, portal area fibrosis, and round cell infiltration; in addition, bile duct proliferation was usually evident, and signs of hepatic cell regeneration were frequently seen; in a few instances, fatty infiltration of hepatic cells was noted; (2) *fatty metamorphosis* was classified as mild, moderate, or marked, depending on the degree of fatty vacuolization; in none of these were there sufficient histologic criteria for rendering an unequivocal microscopic diagnosis of portal cirrhosis; (3) *acute hepatitis* was diagnosed when definite evidence of hepatic cell necrosis and marked inflammatory cellular infiltration were present; and (4) *cholangitis* was diagnosed if an abnormal infiltration of inflammatory cells, usually lymphocytes and plasma cells, into the portal areas, with or without a minimal portal area fibrosis, but with no significant disturbance in lobular architecture, was present.

Of the laboratory procedures, (1) *bromsulfalein retention* was measured at the end of 45 minutes after the injection of 5 mg. of dye per kg. of body weight; (2) *thymol turbidity* was expressed in units according to the technic of Shank and Hoagland (9), for this laboratory 6.5 units is probably the upper limit of normal; and (3) *glucose tolerance* was expressed as mildly, moderately, or markedly decreased if the blood sugar at the end of the second hour was over 120 mg. per 100 cc. but less than 200 mg.; over 200 mg. but less than 300 mg.; and over 300 mg. per 100 cc. of blood, respectively; a "flat curve" did not exceed 140 mg. in any specimen. Only the standard oral glucose tolemnce test was employed.

(9) Shank, R. E., and Hoagland, C. L.: Modified method for quantitative determination of thymol turbidity reaction of serum. J. Biol. Chem. 162: 133-138, Jan. 1946.

TABLE 1. *Summary of clinical findings*

| Patient | Age (years) | Clinical data | | | | | |
|---|---|---|---|---|---|---|---|
| | | Diet | Alcohol intake | Hepatomegaly (cm.) | Jaundice | History of jaundice | Miscellaneous |
| *Group I* | | | | | | | |
| 1 | 54 | Good | None | 6 | No | No | Ascites; edema; splenomegaly, 4 cm. |
| 2 | 52 | Poor | Marked | 10 | Yes | Recurrent for 5 yr. | Ascites; splenomegaly, 3 cm. |
| 3 | 51 | Poor | Marked | 10 | No | No | |
| 4 | 45 | Good | Marked | 6 | No | No | |
| 5 | 55 | Good | Moderate | 6 | Yes | 1946 | |
| 6 | 68 | Good | None | 10 | No | No | Ascites; edema |
| 7 | 53 | Good | None | 0 | Yes | No | Ascites; edema |
| 8 | 53 | Good | Moderate | 4 | Yes | 1946 | Splenomegaly, 6 cm. |
| 9 | 42 | Poor | Unknown | 5 | No | 1942 | |
| 10 | 48 | Good | None | 4 | Yes | No | |
| 11 | 49 | Good | Moderate | 0 | No | No | Ascites; edema; splenomegaly, 3 cm. |
| 12 | 47 | Poor | Marked | 5 | No | No | Ascites; edema; splenomegaly, 4 cm. |
| 13 | 63 | Poor | Marked | 0 | Yes | Unknown | |
| 14 | 63 | Poor | Marked | 8 | No | Unknown | |
| 15 | 53 | Fair | Marked | 4 | Yes | No | |
| 16 | 58 | Fair | Marked | 4 | No | No | |
| 17 | 61 | Good | Moderate | 7 | No | No | |
| 18 | 44 | Poor | Marked | 5 | No | No | |
| 19 | 46 | Fair | Marked | 4 | Yes | No | |
| 20 | 34 | Poor | Marked | 8 | No | 1946 | Ascites |
| 21 | 46 | Poor | Marked | 3 | No | No | |
| 22 | 52 | Fair | Marked | 6 | No | No | |
| 23 | 44 | Good | Moderate | 5 | No | No | |
| 24 | 30 | Good | Moderate | 5 | No | No | |
| 25 | 32 | Poor | Marked | 3 | No | No | |
| 26 | 57 | Fair | Moderate | 5 | No | No | Ascites; edema |
| 27 | 42 | Good | Moderate | 3 | No | No | |
| 28 | 42 | Good | Moderate | 2 | No | No | |
| 29 | 51 | Fair | Marked | 4 | No | No | |
| 30 | 59 | Good | Marked | 0 | No | 1933 | |
| 31 | 52 | Good | Marked | 5 | No | No | |
| *Group II* | | | | | | | |
| 32 | 28 | Good | None | 6 | Yes | No | |
| 33 | 24 | Good | None | 10 | Yes | No | Skin rash; lymphadenopathy |
| *Group III* | | | | | | | |
| 34 | 31 | — | None | 2 | No | 1944 | Prisoner of Japanese for 3 yr. |

TABLE 1. *Summary of clinical findings*—Continued

| Patient | Age (years) | Clinical data | | | | | |
|---|---|---|---|---|---|---|---|
| | | Diet | Alcohol intake | Hepatomegaly (cm.) | Jaundice | History of jaundice | Miscellaneous |
| 35 | 32 | – | None | 0 | No | 1945 | Prisoner of Japanese for 2½ yr. |
| 36 | 52 | Good | None | 2 | No | 1942 | Tenderness in right upper abdominal quadrant |
| 37 | 47 | Good | Mild | 1 | No | 1942 | Tenderness in right upper abdominal quadrant |
| 38 | 29 | Good | Mild | 1 | No | 1946 | Tenderness in right upper abdominal quadrant |
| 39 | 21 | Good | None | 0 | No | 1945 | |
| 40 | 23 | Good | None | 3 | No | 9 mo. earlier | Tenderness in right upper abdominal quadrant |
| 41 | 28 | – | Moderate | 0 | No | 1945 | Prisoner of Japanese for 3 yr. |
| 42 | 42 | Good | None | 0 | No | 1942 | |
| 43 | 26 | Good | Mild | 2 | No | 1943 | |
| *Group IV* | | | | | | | |
| 44 | 55 | Poor | Moderate | 6 | No | No | |
| 45 | 68 | Good | Moderate | 5 | No | No | Essential hypertension |
| 46 | 56 | Good | None | 10 | No | No | Moderate anemia |
| 47 | 35 | Good | Moderate | 6 | No | No | Convalescing from viral pneumonia 3 wk. earlier |
| 48 | 54 | Fair | Moderate | 4 | No | No | |
| 49 | 55 | Fair | Moderate | 6 | No | No | |
| 50 | 51 | Good | None | 10 | No | No | Active far-advanced pulmonary tuberculosis |
| 51 | 22 | – | Moderate | 4 | No | No | Prisoner of Japanese for 3 yr. |
| 52 | 54 | Poor | None | 4 | No | No | Splenomegaly, 4 cm; Active far-advanced pulmonary tuberculosis |
| 53 | 32 | Good | Mild | 6 | No | No | Obese |

TABLE 1. *Summary of clinical findings*—Continued

| Patient | Age (years) | Clinical data | | | | | |
|---|---|---|---|---|---|---|---|
| | | Diet | Alcohol intake | Hepatomegaly (cm.) | Jaundice | History of jaundice | Miscellaneous |
| *Group V* | | | | | | | |
| 54 | 54 | Good | Marked | 10 | No | No | Intermittent congestive heart failure for 2 yr. |
| 55 | 49 | Good | None | 6 | No | No | Edema; congestive heart failure for 2 mo. |
| 56 | 46 | Good | None | 6 | No | No | Edema; intermittent congestive heart failure for 2 yr. |
| 57 | 56 | Good | Moderate | 10 | No | No | Ascites; edema; intermittent congestive heart failure for 2 yr. |
| 58 | 51 | Fair | None | 10 | No | No | Edema; congestive heart failure for 2 mo. |
| *Group VI* | | | | | | | |
| 59 | 76 | Poor | None | 1 | No | No | Pellagralike lesions on hands; pitting of lower extremities |
| 60 | 57 | Fair | Marked | 0 | No | No | |
| 61 | 75 | Good | None | 3 | No | No | Splenomegaly, 5 cm. |
| 62 | 20 | Good | None | 0 | Yes | 6 mo. duration | |
| 63 | 43 | Good | None | 5 | No | No | |
| 64 | 45 | Good | None | 0 | No | No | Obese |
| 65 | 64 | Good | Moderate | 0 | No | No | Hematemesis |
| *Group VII* | | | | | | | |
| 66 | 23 | Good | Moderate | 0 | No | No | |
| 67 | 25 | Good | None | 0 | No | No | |
| 68 | 37 | Good | None | 0 | No | No | |
| 69 | 51 | Good | None | 0 | No | No | |
| 70 | 18 | Good | None | 0 | No | No | |
| 71 | 19 | Good | None | 0 | No | No | |
| 72 | 25 | Good | None | 0 | No | 1947 | |
| 73 | 53 | Good | None | 0 | No | No | |
| 74 | 22 | Good | None | 0 | No | No | |
| 75 | 41 | Good | None | 0 | No | No | Complete situs inversus |
| 76 | 22 | Good | None | 0 | No | 1946 | |
| 77 | 42 | Good | Mild | 0 | No | No | |
| 78 | 57 | Fair | None | 2 | No | No | |
| 79 | 36 | Good | Moderate | 2 | No | No | |
| 80 | 44 | Good | None | 3 | No | No | |
| 81 | 27 | Good | None | 0 | No | No | Active minimal pulmonary tuberculosis |

TABLE 2. *Summary of diagnoses and laboratory procedures*

| Patient | Diagnosis | | Laboratory procedures | | | | |
|---|---|---|---|---|---|---|---|
| | Clinical | Histopathologic | Serum proteins | Bromsulfalein | Thymol turbidity | Icterus index | Glucose tolerance |
| *Group I* | | | | | | | |
| 1 | Portal cirrhosis; diabetes mellitus | Unsatisfactory specimen | 7(2.9/4.1) | 22 | – | 12 | Markedly decreased |
| 2 | Portal cirrhosis | Unsatisfactory specimen | 7(4/3) | 14 | – | 20 | Flat curve |
| 3 | Portal cirrhosis | Unsatisfactory specimen | 7.5(5/2.5) | 10 | – | 8 | Normal |
| 4 | Portal cirrhosis | Unsatisfactory specimen | – | – | – | – | Mildly decreased |
| 5 | Portal cirrhosis | Unsatisfactory specimen | 6.8(5/1.8) | 24 | – | 42 | Moderately decreased |
| 6 | Portal cirrhosis | Portal cirrhosis | 6.7 | 34 | 2.5 | 9 | Mildly decreased |
| 7 | Portal cirrhosis | Portal cirrhosis | 5.3 | 16 | 22 | 30 | – |
| 8 | Portal cirrhosis | Portal cirrhosis | 6.3 | 12 | 12.5 | 24 | Mildly decreased |
| 9 | Portal cirrhosis | Portal cirrhosis | 7.2(4.7/2.5) | 2 | – | 3 | Mildly decreased |
| 10 | Portal cirrhosis | Portal cirrhosis | 7.8(4.2/3.6) | 23 | 3.5 | 16 | Mildly decreased |
| 11 | Portal cirrhosis | Portal cirrhosis | 7.3(4.4/2.9) | – | 25 | 10 | – |
| 12 | Portal cirrhosis | Portal cirrhosis | 7.6(5.4/2.2) | 14 | 9.5 | 12 | Moderately decreased |
| 13 | Portal cirrhosis | Portal cirrhosis | 8.8 | – | – | – | – |
| 14 | Portal cirrhosis | Portal cirrhosis | 6.9 | 17 | 1.5 | – | Mildly decreased |
| 15 | Portal cirrhosis | Portal cirrhosis | 6.3(2.1/4.2) | 26 | 15.5 | 52 | Moderately decreased |
| 16 | Portal cirrhosis; diabetes mellitus | Portal cirrhosis | 8.6(3.5/5.1) | 17 | 60 | 4 | Markedly decreased |
| 17 | Portal cirrhosis | Portal cirrhosis | 8.2(5.1/3.1) | 17 | 2 | 8 | – |
| 18 | Portal cirrhosis; diabetes mellitus | Portal cirrhosis | 7.7(5.2/2.5) | 21 | 7.2 | 6 | Markedly decreased |
| 19 | Portal cirrhosis | Portal cirrhosis | 7 | 24 | 3.8 | 24 | Normal |
| 20 | Portal cirrhosis | Portal cirrhosis | 7.8(5.3/2.5) | 29 | 0 | 12 | Mildly decreased |
| 21 | Portal cirrhosis | Portal cirrhosis | 7.8(5.2/2.6) | 1 | 11 | 4 | Mildly decreased |
| 22 | Portal cirrhosis | Portal cirrhosis | 7(4.3/2.7) | 2 | 8.6 | 4 | – |
| 23 | Portal cirrhosis | Portal cirrhosis | 7.8(3.9/3.9) | 16 | 6.9 | 4 | – |
| 24 | Portal cirrhosis | Portal cirrhosis | – | 22 | 20 | 8 | – |

TABLE 2. *Summary of diagnoses and laboratory procedures*—Continued

| Patient | Diagnosis | | Laboratory procedures | | | | |
|---|---|---|---|---|---|---|---|
| | Clinical | Histopathologic | Serum proteins | Bromsulfalein | Thymol turbidity | Icterus index | Glucose tolerance |
| 25 | Portal cirrhosis | Fatty metamorphosis, marked | 7.4(5.5/1.9) | 29 | 3.5 | 2 | Mildly decreased |
| 26 | Portal cirrhosis | Fatty metamorphosis, marked | 7.7(5/2.7) | 15 | 2 | 3 | – |
| 27 | Portal cirrhosis | Fatty metamorphosis, mild | 7.5(4.8/2.7) | 3 | 3 | 6 | Mildly decreased |
| 28 | Portal cirrhosis | Fatty metamorphosis, marked | 8.2(6.2/2) | 33 | 6 | 4 | Mildly decreased |
| 29 | Portal cirrhosis | Fatty metamorphosis, moderate | 7(4.5/2.5) | 10 | 1.4 | 4 | – |
| 30 | Portal cirrhosis | Fatty metamorphosis, marked | 5.5(3.3/2.2) | 10 | 1 | 1 | – |
| 31 | Portal cirrhosis | Fatty metamorphosis, moderate | 7.5(5.5/2) | – | 3 | 9 | Mildly decreased |
| *Group II* | | | | | | | |
| 32 | Serum hepatitis | Hepatitis, acute | 7.5(4.9/2.6) | 41 | 16 | 45 | Normal |
| 33 | Syphilitic hepatitis | Hepatitis, acute, negative Warthin-Starry stain for spirochetes | 8.1(4.2/3.9) | 41 | 13.5 | 36 | – |
| *Group III* | | | | | | | |
| 34 | Chronic hepatitis | Normal liver | 7(4/3) | – | 6 | 4 | – |
| 35 | Chronic hepatitis | Diffuse hepatitis and cholangitis | 7.5(5.5/2) | 12 | 7 | 4 | – |
| 36 | Chronic hepatitis | Normal liver | 6.5(5.5/1) | 9 | 8 | 4 | Markedly decreased |
| 37 | Chronic hepatitis | Normal liver | 7.5(5/2.5) | 1 | 17 | 6 | Mildly decreased |
| 38 | Chronic hepatitis | Normal liver | 9.1(5.8/3.3) | 20 | 3 | 16 | Flat curve |
| 39 | Chronic hepatitis | Normal liver | – | – | 0 | – | – |
| 40 | Chronic hepatitis | Chronic cholangitis, mild | 8.2(5.1/3.1) | 1 | 5 | 4 | Normal |
| 41 | Chronic hepatitis | Chronic cholangitis, mild | 7.4(5.2/2.2) | 1 | 9 | 6 | Normal |
| 42 | Chronic hepatitis | Normal liver | 7.2(4.4/2.8) | – | 0 | 4 | Normal |

TABLE 2. *Summary of diagnoses and laboratory procedures*—Continued

| Patient | Diagnosis | | Laboratory procedures | | | | |
|---|---|---|---|---|---|---|---|
| | Clinical | Histopathologic | Serum proteins | Bromsulfalein | Thymol turbidity | Icterus index | Glucose tolerance |
| 43 | Chronic hepatitis | Chronic cholangitis, mild | 7.5(5.2/2.3) | 4 | 10 | 4 | Mildly decreased |
| *Group IV* | | | | | | | |
| 44 | Hepatomegaly, cause undetermined; portal cirrhosis | Fatty metamorphosis, marked | 6.7(4.6/2.1) | 14 | 1 | 4 | – |
| 45 | Hepatomegaly, cause undetermined | Normal liver | 7.4(4.8/2.6) | 2 | 1.5 | 4 | Normal |
| 46 | Hepatomegaly, cause undetermined | Normal liver | 7 | 3 | – | 8 | Normal |
| 47 | Hepatomegaly, cause undetermined | Normal liver | 7.8(4/3.8) | 0 | 6 | 3 | Normal |
| 48 | Hepatomegaly, cause undetermined | Chronic cholangitis, mild | 7.2(4.1/3.1) | 2 | 16.4 | 4 | Normal |
| 49 | Hepatomegaly, cause undetermined; possible cholecystitis | Normal liver | 7.2(4.6/2.6) | – | 3 | 10 | – |
| 50 | Hepatomegaly, cause undetermined | Normal liver | 7.5(3.8/3.7) | 5 | 7.6 | 4 | – |
| 51 | Hepatomegaly, cause undetermined | Chronic cholangitis, mild | 6.2(3.4/2.8) | 3 | 7.5 | 4 | Flat curve |
| 52 | Hepatomegaly, cause undetermined | Normal liver | 7.3(3.8/3.5) | 7 | 8 | 4 | – |
| 53 | Hepatomegaly, cause undetermined | Fatty metamorphosis, marked; chronic cholangitis | – | 9 | 3.4 | 4 | Normal |
| *Group V* | | | | | | | |
| 54 | Congestive hepatomegaly | Normal liver | 7.8(5/2.8) | 18 | 4 | 4 | Mildly decreased |
| 55 | Congestive hepatomegaly | Fatty metamorphosis, mild | 8.2(4.8/3.4) | 25 | 15 | 8 | Normal |
| 56 | Congestive hepatomegaly | Normal liver | 6.7(4.4/2.3) | 29 | 4 | 4 | Mildly decreased |
| 57 | Congestive hepatomegaly | Normal liver | 7.2 | 30 | 3 | 6 | Flat curve |
| 58 | Congestive hepatomegaly | Fatty metamorphosis, mild | 7 | 12 | – | 4 | – |

TABLE 2. *Summary of diagnoses and laboratory procedures*—Continued

| Patient | Diagnosis | | Laboratory procedures | | | | |
|---|---|---|---|---|---|---|---|
| | Clinical | Histopathologic | Serum proteins | Bromsulfalein | Thymol turbidity | Icterus index | Glucose tolerance |
| *Group VI* | | | | | | | |
| 59 | Malnutrition (pellagra ?) | Normal liver | 7.5(4.1/3.4) | 2 | 42 | 4 | – |
| 60 | Chronic alcoholism | Normal liver | 7.4(5.1/2.3) | 4 | 1 | 4 | Mildly decreased |
| 61 | Hodgkin's disease | Normal liver | – | – | – | 4 | – |
| 62 | Benign retention jaundice or chronic hepatitis | Normal liver | 8(5/3) | 26 | 1.7 | 24 | – |
| 63 | Diabetes mellitus | Normal liver | – | 2 | – | – | Markedly decreased |
| 64 | Obesity | Fatty metamorphosis, mild | 7.7(4.8/2.9) | 8 | 8 | 4 | Markedly decreased |
| 65 | Peptic ulcer | Normal liver | – | 2 | 3.4 | – | – |
| *Group VII* | | | | | | | |
| 66 | Control | Normal liver | 7.3 | 4 | 6.6 | 6 | – |
| 67 | Control | Normal liver | 7.5(4.5/3) | 2 | 4.4 | 6 | – |
| 68 | Control | Normal liver | – | – | – | – | – |
| 69 | Control | Normal liver | – | – | – | – | – |
| 70 | Control | Normal liver | 7.8(4.8/3) | – | 4.2 | 6 | – |
| 71 | Control | Normal liver | – | – | – | – | – |
| 72 | Control | Normal liver | 6.8(4.8/2) | 2 | 6.2 | 3 | – |
| 73 | Control | Normal liver | 7.5(4/3.5) | 4 | 6.9 | 3 | – |
| 74 | Control | Normal liver | 7.5(5.2/2.3) | 1 | 4 | 4 | – |
| 75 | Control | Normal liver | 8.2(5.1/3.1) | 4 | 1.5 | 4 | Normal |
| 76 | Control | Normal liver | 7.7(5.2/2.5) | 1 | 2 | 4 | Normal |
| 77 | Control | Normal liver | 7(4.9/2.1) | 2 | 4.6 | 4 | – |
| 78 | Control | Normal liver | 8(5.6/2.4) | 1 | 3.5 | 4 | – |
| 79 | Control | Normal liver | 7.5(5.2/2.3) | 0 | – | 4 | Normal |
| 80 | Control | Normal liver | 7(5/2) | 2 | 6.5 | 4 | Normal |
| 81 | Control | Cholangitis, mild | 9(5.2/3.8) | 1 | – | 3 | – |

## CORRELATION OF CLINICAL AND HISTOPATHOLOGIC DIAGNOSES

*Group I, Portal cirrhosis.* In 19 cases the histologic diagnosis unequivocally substantiated the clinical impression. Of the remaining 7 cases of clinically diagnosed portal cirrhosis on whom satisfactory specimens were obtained, fatty metamorphosis in some degree was observed. This finding, in conjunction with the clinical and laboratory

data in each case, was believed to afford sufficient evidence of early portal cirrhosis *(10–14)*.

*Group II. Acute hepatitis.* The two cases of acute hepatitis were substantiated histopathologically although their exact cause was not established. The case of serum hepatitis could not be differentiated from infectious hepatitis histopathologically, but a history of multiple blood transfusions 93 days prior to the onset of jaundice strongly suggested the etiologic basis.

*Group III. Chronic hepatitis.* Of this group 6 showed no abnormality of the specimen obtained by biopsy and 3 were regarded as demonstrating a mild chronic cholangitis. The tenth case showed a diffuse infiltration of inflammatory cells as well as portal area infiltration. All gave a history of previous jaundice varying from 9 months to 5 years prior to the present study. None were clinically jaundiced during the period of observation, although 1 had an elevated icterus index. Of the 6 patients demonstrating no abnormality of the biopsy specimen, 3 showed one or more abnormality of liver function. The difficulties of reaching an accurate diagnosis in the absence of liver biopsy in patients presenting vague symptoms following infectious hepatitis have been stressed by Volwiler and Elliott *(15)*.

*Group IV. Hepatomegaly of undetermined cause.* A liver edge palpable 4 cm. or more below the right costal margin on full inspiration was arbitrarily regarded as abnormally accessible and, in the absence of obvious factors (e. g. pulmonary emphysema) tending to depress the organ lower into the abdominal cavity, the liver was presumed to be enlarged. That such accessibility is not necessarily indicative of pathologic changes in the liver was demonstrated by normal histologic specimens in 6 patients in this group. Of those 4 patients in whom abnormal histopathologic findings were obtained, all were aided by the procedure. In one a diagnosis of early portal cirrhosis (hypertrophic fatty stage) was established; in one the existence of a chronic cholangitis was ascertained; in one an unsuspected low grade cholangitis was found; and in one a moderate cholangitis and a marked fatty metamorphosis were detected.

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*(10)* Connor, C. L.: Etiology and pathogenesis of alcoholic cirrhosis of liver. J. A. M. A. 112: 387-390, Feb. 4, 1939.

*(11)* Hall, E. M., and Morgan, W. A.: Progressive alcoholic cirrhosis; clinical and pathologic study of 68 cases. Arch. Path. 27: 672-690, Apr. 1939.

*(12)* Kirshbaum, J. D., and Shure, N.: Alcoholic cirrhosis of liver; clinical and pathologic study of 356 fatal cases selected from 12,267 necropsies. J. Lab. & Clin. Med. 28: 721-731, Mar. 1943.

*(13)* Gillman, J., and Gillman, T.: Structure of liver in pellagra. Arch. Path. 40: 239-263, Oct. 1945.

*(14)* Moschcowitz, E.: Laennec cirrhosis; its histogenesis, with special reference to role of angiogenesis. Arch. Path. 45: 187-215, Feb. 1948.

*(15)* Volwiler, W., and Elliott, J. A., Jr.: Late manifestations of epidemic infectious hepatitis. Gastroenterology 10: 349-365, Mar. 1948.

*Group V. Congestive hepatomegaly.* The desire to know whether these cases demonstrated any of the histologic features of "cardiac cirrhosis" prompted their inclusion in this series. None showed sufficient histopathologic criteria for a diagnosis of cardiac cirrhosis but all exhibited significant retention of bromsulfalein dye.

*Group VI. Miscellaneous diagnoses.* In view of the work of Gillman and Gillman *(13)* on the development of fatty liver and pigmentary cirrhosis in pellagrins, the finding of normal liver tissue in case 59 was mildly surprising. Possibly it was because of the relatively short duration (1 year) of the patient's dietary inadequacy. Case 60 with marked chronic alcoholism likewise had normal tissue. Such a finding was consistent, however, with the generally accepted belief that dietary factors, not alcohol, are of etiologic importance. Liver biopsy failed to demonstrate the characteristic findings of Hodgkin's disease in case 61. Case 62 gave no family history of jaundice, and demonstrated no anemia or evidence of hemolysis. The serum bilirubin was of the indirect type. The differential diagnosis was between chronic hepatitis and benign retention jaundice (constitutional hepatic dysfunction). The persistent indirect serum bilirubinemia and normal thymol turbidity test favored the latter diagnosis *(16, 17)*. The abnormal bromsulfalein retention, however, and the history of dark urine at the time of first recognition of the jaundice by the patient tended to support the diagnosis of hepatitis. The normal liver biopsy obtained on this patient, however, would seem to favor constitutional dysfunction of the liver *(18)*.

*Group VII. Controls.* This group comprised 16 patients who had been admitted to the hospital for illnesses other than that of the liver or biliary tract. The majority were convalescent and ready for discharge at the time the biopsy was obtained. Two gave a history of infectious hepatitis. Only one exhibited abnormal liver tissue, and this was of questionable significance.

## CLINICAL OBSERVATIONS OF 27 CASES OF PORTAL CIRRHOSIS CONFIRMED BY LIVER BIOPSY

There were 27 patients in whom the clinical and tissue diagnosis was portal cirrhosis, including 8 with fatty metamorphosis. All were male.

*Age.* Their average age was 50 years (range 30 to 68).

*Diet.* Twelve gave a history of having taken a "good" diet, 6 were adjudged to have been only "fair," and 9 "poor."

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*(16)* Dameshek, W., and Singer, K.: Familial nonhemolytic jaundice; constitutional hepatic dysfunction with indirect van den Bergh reaction. Arch. Int. Med. 67: 259-285, Feb. 1941.

*(17)* Comfort, M. W., and Hoyne, R. M.: Constitutional hepatic dysfunction; clinical study of 35 cases. Gastroenterology 3: 155-162, Sept. 1944.

*(18)* Krarup, N. B., and Roholm, K.: Leberbiopsie bei Icterus intermittens juvenilis. Histologische Untersuchungen. Klin Wchnschr. 20: 193-196, Feb. 22, 1941.

*Alcoholism.* Twenty-three gave a history of significant alcoholism. Of these, 14 were "marked" and 9 were "moderate." There were 3 who, so far as could be ascertained, had never taken significant amounts of alcohol, and the habits of 1 were not stated. The incidence of moderate to marked alcoholism in this group of patients thus amounted to 85 percent, an incidence commensurate with that reported by others *(19-21).*

*Antecedent history of jaundice.* Four of the 27 patients gave an antecedent history of jaundice, 1 patient having had 2 episodes. Twenty-one denied having been jaundiced prior to their current hospitalization and in 2 its presence or absence in the past history was not stated. These findings, though statistically of doubtful significance, indicate that only about 15 percent of this group could be related etiologically to a pre-existing clinical infectious hepatitis. Further doubt is cast by the fact that in 2 of these 4 patients the history of antecedent jaundice was less than a year prior to their biopsy.

*Hepatomegaly, splenomegaly, and ascites.* Of the 27 patients with cirrhosis, 23 had palpable livers. In 19, the liver edge could be felt 4 cm. or more below the right costal margin on full inspiration. This finding, confirming the observations of numerous investigators *(19, 20, 22-26)* casts doubt on the accuracy of the term "atrophic" cirrhosis, although in the end stages of the disease the liver may indeed be greatly scarred and shrunken. In only 3 patients could the spleen be palpated. This finding is somewhat at variance with those of the above-cited observers and is probably caused by a portal vein hypertension of a degree insufficient to produce a palpable congestive splenomegaly. The fact that only 6 patients demonstrated clinically detectable ascites favors this explanation.

*Jaundice.* Six of the patients exhibited clinical jaundice during the observation period. Three others had icterus indexes of 10 or more, making a total of 9 patients, or 33 percent, presenting clinical or sub-

*(19)* Gottardo, P., and Winters, W. L.: Portal cirrhosis. Correlation of clinical, laboratory, peritoneoscopic and autopsy findings. Am. J. M. Sc. 204: 205-217, Aug. 1942.

*(20)* Fagin, I. D., and Thompson, F. M.: Cirrhosis of liver; analysis of 71 cases. Ann. Int. Med. 21: 285-297, Aug. 1944.

*(21)* Boles, R. S.; Crew, R. S.; and Dunbar, W.: "Alcoholic cirrhosis." J. A. M. A. 134: 670-673, June 21, 1947.

*(22)* Fleming, R. G., and Snell, A. M.: Portal cirrhosis with ascites; analysis of 200 cases with special reference to prognosis and treatment. Am. J. Digest Dis. 9: 115-120, Apr. 1942.

*(23)* Ratnoff, O. D., and Patek, A. J., Jr.: Natural history of Laennec's cirrhosis of liver; analysis of 386 cases. Medicine 21: 207-268, Sept. 1942.

*(24)* Hoffman, J. (New York), and Lisa, J. R.: Significance of clinical findings in cirrhosis of liver; study of 93 autopsied cases. Am. J. M. Sc. 214: 525-528, Nov. 1947.

*(25)* Chapman, C. B.; Snell, A.; and Rowntree, L. G.: Decompensated portal cirrhosis; report of 112 cases. J. A. M. A. 97: 237-244, July 25, 1931.

*(26)* Chapman, C. B.; Snell, A.; and Rowntree, L.: Compensated cirrhosis of liver; plea for more intensive consideration of earlier stages of disease of hepatic parenchyma. J. A. M. A. 100: 1735-1741, June 3, 1933.

clinical icterus. This incidence is commensurate with that reported by Boles et al. *(21)*, but is somewhat less than that reported by others *(12, 19, 20, 22-24)*. Gottardo and Winters *(19)* and Kimball et al. *(27)* have emphasized the relative frequency with which jaundice occurs in the course of portal cirrhosis, attaching pathogenetic significance to the symptom as expressing hepatocellular degeneration and depression of function.

## CORRELATION OF LABORATORY DATA WITH HISTOPATHOLOGIC DIAGNOSIS

1. Portal cirrhosis

*Erythrocyte count and hemoglobin.* In 15 of the 27 patients with a histopathologic diagnosis of portal cirrhosis, including 8 patients with fatty metamorphosis, an erythrocyte count was recorded. The average count was 4.2 million (range 2.8 to 5.2). Of the 25 patients on whom a hemoglobin determination was made, the average reading was 87 percent. These findings, indicative of a significant incidence of mild anemia, are less marked than those reported in the literature.

*Sedimentation rate (Wintrobe).* These determinations were made on 19 of the 27 patients. The average rate was 23 (range 3 to 56). Seventeen of the patients had rates greater than 10, and in 9, the rate exceeded 20.

*Prothrombin time* was used more as a check on the safety of the biopsy procedure than as a function test. It was not unusual to find slight increases in the prothrombin time (23 to 28 seconds) when compared to a control of 20 seconds. The administration of vitamin K for 2 or 3 days usually resulted in a slight reduction of the prothrombin time to a level regarded safe for the procedure (25 seconds or less).

*Serum proteins* were determined on 26 of the 27 patients, with fractionation of the total proteins in 20 patients. The average total proteins were 7.3 grams per 100 cc. (range 5.3 to 8.8). Only 2 patients had less than 6 grams of serum proteins. Of the 20 total serum proteins which were fractionated, in only 2 patients was the albumin/globulin ratio reversed (less than 1), although 1 patient demonstrated a ratio of 1. The average of 20 serum albumin determinations was 4.6 grams, and the average serum globulin was 2.7 grams. Only 4 patients exhibited a serum albumin less than 4 grams. Five patients had a serum globulin in excess of 3 grams.

*Bromsulfalein retention.* This liver function test was performed on 24 of the 27 patients. In 20 of the 24 patients an abnormal quantity of the dye was present in the serum at 45 minutes. All of these retentions were of the order of 10 percent or more. This test is the simplest and most reliable of the liver function tests for the detection of hepatocellular damage in the absence of jaundice.

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*(27)* Kimball, S.; Chapple, W. H. C.; and Sanes, S.: Jaundice in relation to cirrhosis of liver. J. A. M. A. 134: 662-666, June 21, 1947.

*Cephalin cholesterol flocculation and thymol turbidity.* The cephalin cholesterol flocculation test was performed on 24 of the 27 patients with portal cirrhosis, including the 8 with fatty metamorphosis. Only 4 positive tests were obtained, and the maximum degree of positivity noted was a 2-plus reaction at 48 hours. The thymol turbidity test was performed on 25 patients including the 8 cases in the hypertrophic fatty stage; in 11, the test was abnormally elevated. Of these 11, the average was 18 units (range 6.9 to 60). With one exception, the abnormal cephalin cholesterol flocculation tests were found in the patients demonstrating the highest degree of thymol turbidity. In the one exception, a 2-plus flocculation at 48 hours was associated with a thymol turbidity of 3.5 units. In none of the 8 patients with hypertrophic fatty cirrhosis was either an abnormal cephalin cholesterol flocculation or thymol turbidity test obtained. If these 8 patients are excluded, a positive thymol turbidity test was obtained in 65 percent.

*Icterus index and serum bilirubin.* One or more icterus indexes was obtained on 25 of the 27 patients with portal cirrhosis. Of this number, 8 had indexes of 10 or more. Serum bilirubin determinations were made on 11 of the 27 patients. Four of these exceeded 1.2 mg. per 100 cc.

*Glucose tolerance test.* A standard oral glucose tolerance test was made on 16 of the 27 patients. Two gave histories suggestive of pancreatic diabetes (glycosuria, polydipsia, polyuria, polyphagia) and their markedly decreased tolerance for oral glucose was thought to reflect both pancreatic and liver disease. Of the remaining 14 cirrhotic patients, 10 showed definite periportal fibrosis, whereas 4 demonstrated fatty metamorphosis in the absence of significant portal area fibrosis. Of the 10 patients exhibiting portal fibrosis, 1 had a normal glucose tolerance, and 7 demonstrated a mild decrease and 2 a moderate decrease in glucose tolerance. No correlation could be shown between the degree of fatty metamorphosis and the degree of diminished glucose tolerance. All of the other 4 patients exhibited a mild decrease in tolerance.

2. Fatty metamorphosis.

When the 8 cirrhotic patients whose principal histopathologic features were fatty metamorphosis are grouped with the others demonstrating fatty changes, 2 histologic-functional correlations were suggested. In 10 of 11 patients on whom the bromsulfalein retention test was done, there was an abnormal retention. In 5 of 7 patients a decrease in glucose tolerance was observed. There was no disturbance in serum proteins in any of the 12 patients, and negative cephalin cholesterol flocculations were obtained in all of 10 patients. In 2 of 11 patients, mild increases in the thymol turbidity test were observed. In the structural and functional correlation studies of Franklin et al. (28), no significant relation between fatty changes in the liver and any of the function tests was noted. Diffuse liver cell damage, in their

(28) Franklin, M.; Popper, H.; Steigmann, F.; and Kozoll, D. D.: Relation between structural and functional alterations of liver. J. Lab. & Clin. Med. 33: 435-447, Apr. 1948.

experience, was the only histopathologic substratum for bromsulfalein dye retention. No observations were made by them with respect to glucose tolerance.

3. Acute hepatitis.

The widespread nature of the inflammatory process in the 2 patients with acute hepatitis was reflected in the laboratory data. Both demonstrated elevated icteric indexes with moderate increases in the direct serum bilirubin. Both likewise showed markedly abnormal bromsulfalein retentions, and significant increases in the thymol turbidity test. The patient with serum hepatitis showed no disturbance in total or fractional serum proteins, and exhibited only a trace—1-plus cephalin flocculation. The patient with acute hepatitis of undetermined cause had a serum globulin of 3.9 grams per 100 cc. and exhibited a 4-plus - 4-plus cephalin flocculation.

4. Chronic cholangitis.

A histopathologic diagnosis of cholangitis was made on 8 patients; 4 with a clinical diagnosis of chronic hepatitis; 3 with hepatomegaly of undetermined cause; and 1 control. The only consistent abnormality noted among the several laboratory tests was the thymol turbidity test. Five of 7 patients on whom this test was performed showed an average elevation of 10 units (range 7 to 16.4). In 2 of the 8 patients an abnormal retention of bromsulfalein was found; 1 of these had an associated marked fatty metamorphosis. There were no positive cephalin flocculations among the 7 patients tested. The above laboratory findings are in general agreement with those reported in the literature *(9, 28, 29)*. Three of our 6 patients with clinically diagnosed chronic hepatitis from whom normal liver tissue was obtained demonstrated 2 or more abnormal laboratory findings.

5. Group VI.

These patients all presented normal liver tissue except 1 who had a clinical diagnosis of obesity. He exhibited mild fatty changes in his hepatic cells which probably accounted for the slight abnormalities of both the bromsulfalein and thymol turbidity tests. His markedly decreased glucose tolerance is open to conjecture. Newburgh and Conn *(30)* postulated that the abnormally decreased glucose tolerance curves which they demonstrated in obese persons, and which were converted to normal with a reduction in weight were caused by fatty infiltration of the liver. The observation made on our patient as well as the finding of decreased glucose tolerance in 4 of 6 other patients with mild to marked fatty metamorphosis would tend to support this postulate. An alternative explanation of diminished tolerance in obese patients is

*(29)* Stillerman, H. B.: Thymol turbidity test in various diseases. J. Lab. & Clin. Med. 33: 565-572, May 1948.

*(30)* Newburgh, L. H., and Conn, J. W.: New interpretation of hyperglycemia in obese middle-aged persons. J. A. M. A. 112: 7-11, Jan. 7, 1939.

that of a markedly increased total metabolism in a patient with a latent hypoinsulinism.

6. Group VII.

Serum protein determinations, bromsulfalein retention tests, thymol turbidity tests, icterus indexes, and glucose tolerance tests performed on selected patients from the control group were all within the normal range, including the patient in whom a mild cholangitis was reported.

## MORTALITY AND COMPLICATIONS

The fact that needle biopsy entails some risk has been pointed out by Hoffbauer *(5)*. Sherlock *(31)* and Volwiler and Jones *(32)* have reported mortality rates of 0.67 and 0.5 percent, respectively. There was 1 death (Case 58) in our series which must be regarded as incident to the biopsy procedure despite the failure to demonstrate with certainty the site of bleeding at the postmortem examination. The patient died suddenly during surgical intervention for intraperitoneal hemorrhage 4 days following the biopsy. He was a 51-year-old Latin-American who gave a history of hypertension of 10 years' duration. On admission he had symptoms and signs of congestive heart failure of 2 months' duration. His blood pressure was 180/120. A diagnosis of hypertensive heart disease was made, and treatment consisted of bed rest, low salt diet, mercurial diuretics, and digitalis. After about 1 week all symptoms of cardiac failure had disappeared. An ECG showed marked left axis deviation and evidence of myocardial damage but there were no changes indicative of recent or old infarction. The patient's course was uneventful and he was apparently well compensated, but his liver remained palpable 10 cm. below the costal margin. A bromsulfalein test demonstrated 12 percent retention at 45 minutes. Continued observation brought no explanation for the remarkable hepatomegaly which seemed difficult to relate entirely to the previous episode of cardiac failure. After 1 month's observation during which there occurred no change in the degree of hepatomegaly, a needle biopsy was performed. There were no immediate complications except mild upper abdominal pain readily controlled by codeine. After 24 hours' restriction to bed, the patient was allowed to be ambulatory. On the third day after the biopsy he complained of vague distress on the right side of the abdomen, and pallor was observed. The abdomen was moderately doughy. The blood pressure was 110/80. The erythrocyte count was 2,500,000, hemoglobin 6 grams, hematocrit 29.5 percent, and leukocyte count 30,000. A transfusion of 1,000 cc. of blood restored the hematocrit to 38 percent, the hemoglobin to 11 grams, and the blood pressure to 150/100. A surgical consultant recommended 24 hours' observation for evidence of further bleeding. On the fourth postbiopsy day, the clinical and laboratory

*(31)* Sherlock, S.: Aspiration liver biopsy; technique and diagnostic application. Lancet 2: 397-401, Sept. 29, 1945.

*(32)* Volwiler, W., and Jones, C. M.: Diagnostic and therapeutic value of liver biopsies, with particular reference to trocar biopsy. New England J. Med. 237: 651-656, Oct. 30, 1947.

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findings indicated continued bleeding and a transfusion of 1,500 cc. of blood was given in preparation for operation. On entering the peritoneal cavity, a gush of about 500 cc. of dark red blood escaped from the wound, and the patient's pulse, blood pressure, and cardiac impulse immediately became imperceptible. Cardiac massage and artificial respiration were of no avail.

Postmortem examination confirmed the clinical impression of hypertensive heart disease. The heart weighed 675 grams. There was marked coronary atherosclerosis and the left circumflex branch was completely occluded by an organized thrombus. The abdominal cavity contained about 500 cc. of fluid and clotted blood. The liver weighed 1,525 grams and its capsule was thin, smooth, and glistening. In the right lobe of the liver opposite the anterior axillary line at the level of the eighth interspace was a small punctate area, the site of the biopsy wound. This was well healed grossly and microscopic sections through the area revealed the biopsy tract filled with fibrin clot with areas of beginning hyalinization. Opposite the biopsy site in the liver was a small punched-out area 1 mm. in diameter in the right leaf of the diaphragm. This wound was situated immediately above the level of attachment of the diaphragm to the thoracic wall and presented a small reddish halo about 0.5 cm. in diameter on the peritoneal surface. Dissection of the eighth intercostal space in the area of the biopsy revealed intact intercostal vessels. Sections of the liver revealed moderate passive congestion and mild fatty metamorphosis; there was no periportal or central lobular fibrosis.

Although the death of this patient must be attributed to the biopsy procedure, there is doubt that the liver was the site of the hemorrhage. At the time of surgical intervention, visualization of the right lobe of the liver disclosed a smooth and glistening capsule with no indication of the biopsy site. At the postmortem examination it was possible to recognize the biopsy site only by the slightly darkened and depressed punctate area noted above. Moreover, the punched-out character of the diaphragmatic wound which presented no evidence of organization suggested the possibility that this structure might have been the source of the bleeding.

Other complications of the biopsy procedure were a minimal traumatic pneumothorax in 3 patients, a subcutaneous hematoma at the biopsy site in 1, and the occasional occurrence of moderate pain in the right upper abdominal quadrant. The former was recognized by a slight hissing sound at the time of withdrawal of the obturator when the end of the needle had failed to penetrate the capsule of the liver and lay within the lower aspect of the pleural sinus. When this occurred, the obturator was replaced and the needle advanced until the liver was penetrated. No sequelas attended these pneumothoraces, the small amount of air in the pleural space was absorbed within 24 to 48 hours.

Moderate pain in the right upper abdominal quadrant accentuated by respiration and referred to the right shoulder occasionally persisted for

from 12 to 24 hours following biopsy. This was probably caused by the leakage of a small amount of blood from the biopsy site in the liver into the subphrenic space with diaphragmatic irritation, as observed by Hoffbauer *(5)* by means of simultaneous needle biopsy and peritoneoscopy. In each instance the pain was readily controlled by analgesic drugs.

## FUTURE APPLICATIONS OF LIVER BIOPSY

Until recently, needle biopsy of the liver had found its greatest usefulness as an adjunct in the diagnosis of primary and secondary liver disease. Baron *(6)* thought the procedure had great value in the diagnosis of metastatic carcinoma and in the differential diagnosis of jaundice. Hoffbauer et al. *(8)* have used the needle biopsy as a histopathologic control in the construction of liver "profiles," graphic representations of deviation from the normal of a group of well-established liver function tests. It was their opinion that certain types of liver disease as well as extrahepatic biliary obstruction exhibited fairly characteristic profiles on these composite function charts. Sanes et al. *(33)* have recently reported the needle biopsy as particularly helpful in patients with unexplained hepatomegaly; for the exclusion of primary hepatic disease; in the elucidation of the etiology of jaundice; for confirmation of portal cirrhosis; in determination of the coexistence of primary liver cell carcinoma in portal cirrhosis; as a guide before undertaking certain types of therapy; to follow the course of hepatic disease; and as a postmortem procedure in lieu of complete autopsy where the clinical diagnosis of liver disease was in doubt. Kumpe et al. *(34)* and Safdi et al. *(35)* have reported success with needle biopsy as a diagnostic procedure, particularly in the histopathologic diagnosis of primary and secondary neoplasms of the liver. Koch and Karl *(36)* have found needle biopsy of value in differentiating "medical" and "surgical" jaundice. Topp and Lindert *(37)* were able to diagnose with absolute certainty 6 cases of hemochromatosis, even in the absence of skin pigmentation, positive skin tests for iron, and clinical or laboratory diabetes. The possibilities of the usefulness of needle biopsy in affording a better understanding of associated hepatic involvement in cholelithiasis and peptic ulcer have been raised by Mateer et al. *(38)*.

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*(33)* Sanes, S.; Chapple, W. H. C.; Onorato, V. A.; and Marchant, E.: Diagnostic experience with hepatic specimens obtained by needle puncture. New York State J. Med. 48: 398-400, Feb. 15, 1948.

*(34)* Kumpe, C. W., and others: Needle biopsy of liver; general considerations. Gastroenterology 9: 672-681, Dec. 1947.

*(35)* Safdi, S. A.; Gall, E. A.; Kumpe, C. W.; and Schiff, L.: Needle biopsy of liver; experiences with malignant neoplasm. Gastroenterology 11: 93-99, July 1948.

*(36)* Koch, R. E., and Karl, M. M.: Clinical use of needle biopsy of liver. Gastroenterology 10: 801-812, May 1948.

*(37)* Topp, J. H., and Lindert, M. C. F.: Diagnosis of hemochromatosis by means of needle biopsy of liver. Gastroenterology 10: 813-821, May 1948.

*(38)* Mateer, J. G., and others: Combined liver biopsy and liver function study in 132 cases of cholelithiasis and 31 cases of peptic ulcer (operated cases). (Emphasis upon early microscopic liver disease and particularly acute infiltrative hepatitis and microscopic periportal cirrhosis.) Gastroenterology 11: 284-302, Sept. 1948.

Of equal importance in liver disease is the value of liver biopsy as a guide to therapy and as a prognostic tool in determining the degree of hepatic cell regeneration that may be anticipated from therapy. Of even greater importance from the therapeutic standpoint is the use of the needle biopsy as an almost absolute control in evaluating any therapy in liver disease, particularly portal cirrhosis. Furthermore, the needle biopsy places in the hands of the pathologist and biochemist an ideal tool for portrayal of the natural histopathologic and biochemical history of various liver disorders. Of prime importance in this connection would be studies of those cases of infectious hepatitis that slowly progress into the chronic hepatitis stage. Serial biopsies for both histologic and biochemical examination of a sufficient number of such cases should aid in elucidating the development of "cholangiolitic cirrhosis" and the relationship of infectious hepatitis and portal cirrhosis of the Laennec type.

# Narcotic Addiction

## Management of Withdrawal Symptoms With Cortisone

Wade H. Boswell, *Lieutenant Commander, MC, U. S. N.* (1)

MORPHINE, the synthetic narcotics, and the related alkaloids of opium have peculiar effects on the psychic functions which render the users more tolerant to discomfort and pain. This gives these drugs a wide field of usefulness, especially in the relief of pain (2), but it also leads easily to their abuse, too often with tragic results. The cause of narcotic addiction varies, but the addict himself cannot be believed regarding the origin of his habit. The addiction is generally a symptom of psychologic maladjustment. The use of an opiate provides an escape from reality, a release from the failures and disappointments of everyday life. The exact incidence of narcotic addiction in the United States is reported to be 1 in 5,000 (3). The greatest number begin their addiction between 20 and 29 years of age; next come the adolescents; and very few start after 50 (4). (Ed. note: Recently it has been noted that a large number of teen-agers have become addicted to narcotics. The cause in this instance appears to be merely thrill-seeking and/or curiosity.) Great care must be exercised in prescribing narcotics as some patients with unstable personalities may become addicted after only a few doses. By far, the greatest percent of addicts become addicted by choice, through associates or curiosity.

The popular conception of the addict as a cunning, cringing, malicious, and degenerate criminal who is shabbily dressed, physically ill, and devoid of the social amenities could not be farther from the truth. When the addict is properly dressed and fed and receives his daily drug requirement, he cannot be distinguished from other persons. He remains in excellent health and suffers no inconvenience or physical abnormalities unless he ceases to take the drug. Ill health, crime, degeneracy, and a low standard of living are the result not of the

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(1) U. S. S. *Consolation.*

(2) Sollman, T.: Manual of Pharmacology. W. B. Saunders Co., Philadelphia, Pa., 1943. pp. 268-290.

(3) United States Treasury Department, Bureau of Narcotics: Traffic in Opium and Other Dangerous Drugs for the Year Ended December 31, 1938. Report by the Government of the United States of America. Government Printing Office, Washington, D. C., 1939.

(4) Pescor, M. J.: Statistical analysis of clinical records of hospitalized drug addicts. U. S. Public Health Report. Supp. No. 143, 1938.

pharmacologic effects of the drugs but of the sacrifice of money, social position, food, and self-respect in order to buy the daily dose of the drug. Drug addiction is often difficult to recognize. There may be scars and abscesses of the skin caused by repeated infections if the drug has been injected without aseptic technic. In the last analysis, the only true diagnostic test for addiction is the occurrence of a fairly typical train of abstinence symptoms on withdrawal of the drug, which are relieved by an injection of the drug.

The character and severity of the withdrawal symptoms depend on the health and personality of the patient, the duration of the addiction, the dose of the narcotic, the interval between doses, and the type of treatment instituted. Although psychic factors are undoubtedly important in determining the character of the withdrawal symptoms, some of the signs and symptoms are so constant and severe as to suggest a deeper basis than hysteria, despite the fact that such a basis remains undisclosed. Symptoms generally start within the first day after the last dose of the drug is omitted. They are usually quite severe within 2 days, reach their peak in 3 to 4 days, and are definitely on the decline by the fifth day, disappearing on the eighth day.

TABLE 1.—*The abstinence syndrome**

| *Mild, or one plus* | *Marked, or three plus* |
|---|---|
| Yawning | Fever |
| Lacrimation | Increase in respiratory rate |
| Rhinorrhea | Restlessness |
| Perspiration | Insomnia |
| *Moderate, or two plus* | *Severe, or four plus* |
| Muscle tremor | Vomiting |
| Gooseflesh | Diarrhea |
| Loss of appetite | Weight loss |
| Dilated pupils | |

* Himmelsbach, C. K.; Eddy, N. B.; and Davenport, L. F.: Clinical studies on drug addiction, with special reference to opium derivatives and allied synthetic substances. Public Health Report. Supp. 138: 114-129, 1938.

The cardinal features of the abstinence syndrome are summarized in table 1 which lists the signs in their approximate order of appearance but chiefly with regard to their significance for an estimation of the intensity of the withdrawal syndrome. The failure to take food and fluid, combined with vomiting, sweating, and diarrhea, results in weight loss, dehydration, and acidosis. Muscle pains in the abdomen, back, and extremities are also quite characteristic and are particularly severe in the popliteal region. Sometimes cardiovascular collapse may appear, and this may require the subcutaneous administration of from 10 to 15 mg. of morphine which relieves the dangerous symptoms within from 5 to 30 minutes. The management of narcotic addiction is a highly

specialized problem, the solution of which requires combined medical, nursing, and psychiatric care. Many routine systems of treatment have existed in the past, either slow, rapid, or abrupt. All have had many undesirable features.

Recently, aboard this hospital ship operating in the Korean theater, many patients with frostbite and burns have been treated with oral cortisone *(5)*. During this treatment psychic changes were noted similar to those observed by other investigators *(6-10)*. These changes have been a feeling of well-being, increased self-confidence, an optimistic, elated mood, and an acceleration in the thinking and physical activities. This was coupled with marked increase in appetite and fluid intake.

As the psychic untoward effects of cortisone therapy closely parallels the desired response of the drug addict, and because physiologic changes brought about by the drug might alter the abstinence symptoms, it was decided to institute cortisone therapy on a drug addict.

## CASE REPORT

On 17 February 1951 a 27-year-old medical officer with 5 months' service was admitted to the sick list at a field hospital in Korea with the diagnosis "Observation, psychiatric" after his narcotic records had been checked, and it was determined that between 21 November 1950 and 12 February 1951 his unit had drawn 2,770 cc. of demerol solution (50 mg. per cc.) and 23 grams of morphine sulfate. This was far in excess of that used by all the rest of the hospital in which he worked. He was immediately transferred to this ship.

On admission he readily admitted taking an average of 60 cc. of demerol and 1 gram of morphine daily. This was self-administered intravenously, usually 6 times daily with ten 16 mg. morphine tablets dissolved in 10 cc. of demerol solution. Physical examination revealed many punctures of the skin over superficial veins, many of which were thrombosed.

Within 24 hours after admission he developed moderate gastric cramps and vomited. Within the next 2 hours abdominal pain increased, and several fluid bowel movements occurred. He began to be apprehensive,

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*(5)* Boland, E. W., and Headley, N. E.: Oral use of cortisone acetate. J. A. M. A. 145: 8-10, Jan. 6, 1951.

*(6)* Thorn, G. W.; Forsham, P. H.; Frawley, T. F.; Hill, S. R., Jr.; Roche, M.; Staehlein, D.; and Wilson, D. L.: Clinical usefulness of ACTH and cortisone. New England J. Med. 242: 789-793, May 18, 1950.

*(7)* Rome, H. J., and Braceland, F. J.: Use of cortisone and ACTH in certain diseases: psychiatric aspects. Proc. Staff Meet. Mayo Clin. 25: 495-497, Aug. 16, 1950.

*(8)* Perera, G. A.; Fleming, J. C.; Pines, K. L.; and Crymble, M.: Cortisone in hypertensive vascular disease. J. Clin. Investigation 29: 739-744, June 1950.

*(9)* Sprague, R. G.; Power, M. H.; and Mason, H. L.: Physiological effects of cortisone and pituitary adrenocorticotropic hormone (ACTH) in man. J. A. M. A. 144: 1341-1347, Dec. 16, 1950.

*(10)* Kendall, E. C.: Cortisone. Ann. Int. Med. 33: 787-796, Oct. 1950.

weak, and broke out in a cold sweat. The pulse rate increased, and the blood pressure fell. To establish a definite diagnosis, 10 cc. of demerol solution was given intravenously following which he had complete relief of symptoms, and 5 hours of sleep followed.

During the next 12 hours he was given 2 further injections of demerol solution and at 1100 on 19 February, 18 hours after the onset of symptoms, he was started on cortisone acetate by mouth. He was given (1) 100 mg. of cortisone and 0.5 mg. of potassium chloride every 6 hours for 4 doses; (2) 50 mg. of cortisone and 0.5 mg. of potassium chloride every 6 hours for 3 days; and (3) 25 mg. of cortisone and 0.5 mg. of potassium chloride every 6 hours for 1 day. About 1 hour after the first dose of cortisone was given he showed evidence of early shock, and 16 mg. of morphine was given hypodermically. Again at 1500 shock was imminent, and the morphine injection was repeated. By 2200 his general condition had improved. He was able to take food and fluid. By 1200 on 20 February he was completely asymptomatic. His appetite increased, and on the third, fourth, and fifth days of treatment he ate an average of 4 rations at each of the regular meals, extra milk between meals, and a midnight ration. During these 3 days he consumed 36 bars of candy, and his fluid intake was greatly increased. During this period he was mildly euphoric. Although physically tired he was mentally alert, reading or working mathematical problems. For the entire period of treatment and for 2 days following he was unable to sleep. The night after treatment was terminated, he slept for 2 hours which increased several hours a night until by the fifth night after treatment was terminated he was sleeping 7 or 8 hours nightly.

During the 10 days of posttreatment observation there was no evidence of mental depression. There was no general malaise and his appetite remained good. During the 15 days of hospitalization he gained 15 pounds. He was transferred to a hospital in Japan and was seen 2 weeks later. He had continued to gain weight and his mental outlook was improved.

## DISCUSSION

An addict cannot be trusted to give an honest report of his drug consumption because he believes that by exaggerating his needs he will more easily succeed in obtaining what he desires. The exact amount taken by our patient was reported to be 60 cc. of demerol solution and 1 gram of morphine daily. Although this might have been exaggerated somewhat there is no doubt of his addiction as he had no unusual response to 10 cc. of demerol solution intravenously and no unusual response to repeated doses of 9 and 8 cc. 4 and 8 hours later. The development of severe abstinence symptoms occurred within 24 hours after his admission. Cortisone was administered, and complete relief of symptoms was obtained at the time it would normally be expected for the symptoms to be at their peak.

The above findings are similar to those found by Smith *(11)* in the treatment of delerium tremens with ACTH. In both acute alcoholic intoxication and delerium tremens *(12)* it is reported that the drug markedly speeds recovery, as compared to that anticipated from conventional therapy. The report of Thorn *(13)* indicates that in 2 patients with severe personality disorders, one addicted to codeine and the other to morphine, attempts at withdrawal during ACTH therapy were unsuccessful.

*(11)* Smith, J. J.: Treatment of acute alcoholic states with ACTH and adrenocortical hormones. Quart. J. Stud. Alcohol. 11: 190-198, June 1950.

*(12)* Smith, J. J.: Role of Adrenal Gland in Alcoholism. In Proceedings of the First Clinical ACTH Conference. J. R. Mote, editor. The Blakiston Co., Philadelphia, Pa., 1950. p. 544.

*(13)* Thorn, G. W.; Forsham, P. H.; Frawley, T. F.; Hill, S. R., Jr.; Roche, M.; Staehlein, D.; and Wilson, D. L.: Clinical usefulness of ACTH and cortisone. New England J. Med. 242: 865-872, June 1, 1950.

# Treatment of Malignancy of the Testes

James C. Kimbrough, *Colonel, MC, U. S. A.* (1)

William H. Morse, *Captain, MC, U. S. A.* (1)

OUR purpose in this article is to emphasize the importance of early diagnosis and early and radical surgical procedures in the treatment of malignant tumors of the testes and to report the high mortality and morbidity rates resulting from minor operations and palliative radiation therapy.

## INCIDENCE

Although malignant tumors of the testes are rare, delay in diagnosis and treatment is attended with such high mortality that they should be looked for in every physical examination. They usually occur in patients between 20 and 40 years of age. Because of this age factor, a high incidence is observed when a large number of men are inducted into the service. Between October 1940 and May 1946, Friedman and Moore (2) reported 922 cases at the Armed Forces Institute of Pathology. With the current increase in the Armed Forces a corresponding rise of incidence may be expected.

Malignant tumors of the testes arise from totipotent sex cells. The monodermal forms of these growths represent one-sided developments of tridermal teratomas. These tumors are often mixed in type. If one type predominates, the minor elements may not be found at the pathologic examination. A seminoma (germinoma) which appears monodermal may contain subversive elements of embryonal carcinoma, chorioepithelioma, et cetera. These unrecognized elements at times metastasize independently of the seminoma. The structural pattern may be classified as follows: (1) radio-sensitive—seminoma; and (2) radio-resistant—embryonal carcinoma, teratoma, teratocarcinoma, and miscellaneous tumors.

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(1) Walter Reed Army Hospital, Washington, D. C.

(2) Friedman, N. B., and Moore, R. A.: Tumors of testis; report of 922 cases. Mil. Surgeon 99: 573-593, Nov. 1946.

Seminoma is the precursor of embryonal carcinoma, teratocarcinoma, and chorioepithelioma. Seminomas may metastasize as embryonal carcinomas or other types.

## TREATMENT

Although seminomas are more radio-sensitive than the other types, because they may metastasize as a radio-resistant type, radiation therapy alone cannot be depended on to control the tumor spread. Friedman and Moore found 319 patients with seminoma in their series of 922. Metastases were found in 28 of these patients with seminoma. In a later report, Friedman (3) noted that of the 28, the metastasis was embryonal carcinoma, teratocarcinoma, or some other type in 11 patients (39.3 percent). This kind of radio-resistant metastasis makes radical surgical excision of the retroperitoneal lymphatics, testis, and spermatic cord the treatment of choice. The operation is followed by appropriate irradiation. The radical treatment has given better results than simple orchiectomy with irradiation.

O'Connell and Geschickter (4) reported the 5-year survival rate for 216 patients with malignancy of the testes treated at the National Naval Medical Center, Bethesda, Md. The standardized treatment consisted of ligation of the cord at the internal inguinal ring and excision of its distal portion along with the testis, followed by irradiation.

TABLE 1.—*Comparison of survival rates of series of patients*

| Classification | U. S. Naval Hospital (4) | | Walter Reed Army Hospital (5) | | Difference |
|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | |
| Radio-sensitive: seminoma | 75 | 59.6 | 103 | 81 | 21.4 |
| Radio-resistant: teratocarcinoma, embryonal carcinoma | 141 | 19.1 | 100 | 37 | 17.9 |
| Total | 216 | 31.7 | 203 | 57 | 25.3 |

Hampton (5) has summarized the 5-year survival rate of a group of 203 patients evaluated at this hospital. The standardized treatment was radical orchiectomy with resection of the iliac and preaortic lymph nodes, vas deferens, and spermatic vessels, followed by irradiation. Table 1 compares the 5-year survival rate from the two reports.

(3) Friedman, N. B.: Comparative morphogenesis of extragenital and gonadal teratoid tumors. Cancer 4: Mar. 1951.

(4) O'Connell, H. V., and Geschickter, C. F.: Tumors of testes; 5-year follow-up study. U. S. Armed Forces M. J. 1: 719-732, July 1950.

(5) Hampton, A. O.: Delayed effects of million volt irradiation on gastrointestinal tract and on testicular tumors. Project No. 100, Radiation Therapy Service, Walter Reed Army Hospital, Preliminary Progress Report, Dec. 31, 1950.

## CONCLUSIONS

The treatment of malignant disease by excision of the local tumor is an obsolete measure attended by metastases, high mortality, and painful death. Cancer is a serious disease and the chances for cure are enhanced by early radical surgical excision. Timid or conservative use of the scalpel leads to dire and fatal consequences. Early diagnosis with radical surgical excision of the tumor, spermatic cord, and regional lymphatics is imperative in the management of malignant tumors of the testis.

# Histamine as a Factor in Dental Inflammation

Merle W. Ogle, *Lieutenant Colonel, DC, U. S. A. (1)*

Ralph B. Lydic, *First Lieutenant, DC, U. S. A. (1)*

NORMALLY a physiologic balance in tissues of the oral cavity is maintained even though a number of factors exist which may predispose to or complicate inflammatory processes. Such factors include: erupting teeth; local irritants, such as fermentative or putrefactive substances; excessive bacterial activity; occlusal trauma, in excess of ability of supporting structures of teeth to resist damage; and other chemical or physical irritants. Conditions may exist in the oral cavity which influence or are influenced by a seemingly remote systemic irregularity. Basic information is necessary to evaluate and differentiate normal and pathologic reactions wherever they may occur. Stimuli associated with normal physiologic processes may deviate from their usual quality and quantity and cause inflammation.

Allergic and anaphylactic manifestations cause inflammation. An example of allergic inflammation is the Arthus phenomenon in which the injection of a substance into an animal previously treated with that same substance results in a severe local reaction. Theories have been advanced that this is caused by a local antigen-antibody reaction; a local concentration of a foreign protein; or a general alteration of the mesenchyme, a hyperergy which increases local reaction.

Allergy is believed to play a part in the inflammation found in infectious diseases including syphilis, tuberculosis, and rheumatic fever. Acute inflammation of the allergic type is seen in cutaneous flares and wheals, diagnostic skin reaction, coryza, bronchitis, and other conditions which develop in persons who are hypersensitive to specific proteins. The allergic inflammatory reaction is like other inflammations except that the exudate may contain more eosinophils.

Lewis and Grant *(2)* suggested that a histaminelike substance is involved in the reactions of the skin to injury and that this substance

*(1)* Brooke Army Hospital, Fort Sam Houston, San Antonio, Tex.

*(2)* Lewis, T., and Grant, R. T.: Vascular reactions of skin to injury; liberation of a histamine-like substance in injured skin; the underlying cause of factitious urticaria and of wheals produced by burning; and observations upon nervous control of certain skin reactions. Heart 11: 209-265, May 1924.

held normally within cells is released by various types of injury and, diffusing out, causes the early changes in capillary dilatation and permeability which in turn produce local edema and redness. Since this work, investigators have questioned whether or not histamine may play a role in inflammation. That histamine is among the substances released by stimuli has been shown by Rosenthal and Tabor (3).

Histamine itself is a strongly basic, water soluble, white, crystalline compound derived from histadine (one of the essential amino acids) by decarboxylation (4). It is produced regularly in the intestines by organisms of the Escherichia group. It is present in the tissues generally, and even in the leukocytes, but how it is formed in the tissues is not known. Histamine stimulates the gastric secretion, dilates the capillaries and arterioles, lowers blood pressure, constricts the bronchioles, contracts the sphincter of the hepatic veins, dilates the pial vessels, and raises the pressure of the cerebrospinal fluid. It is an antagonist to epinephrine and probably acts as a stimulus to its production. It is liberated from the tissues in anaphylactic and allergic reactions and is neutralized by histaminase (5). There is abundant evidence that histamine plays a major role in anaphylactic and allergic reactions.

Most, if not all, of the body cells which exhibit a vigorous metabolism contain histamine as a normal constituent. Stimuli applied to such cells, if strong enough to entail even mild injury, cause this histamine to be liberated from the cells in sufficient amounts to cause dilatation of the adjacent capillaries to a mildly pathologic degree (5). Menkin (6), on the other hand, is not fully in accord with the views held by some other investigators. He has isolated a factor in inflammatory exudate which increases permeability of the capillary wall. It is not a protein substance but contains amino and carboxyl groups, appearing to belong to the relatively simple polypeptides (7). He believes it is not histamine or an H-substance. It has been isolated and crystallized and is called leukotaxine.

In spite of these variations in ideas investigators have shown that well-developed inflammatory areas in laboratory animals and in human beings contain amounts of histamine well above normal. It is clear then that either the increased histamine is brought to areas of inflammation through the blood stream or else some local mechanism is stimulated

(3) Rosenthal, S. M., and Tabor, H.: Improved colorimetric method for estimation of histamine. J. Pharmacol. & Exper. Therap. 92: 425-431, Apr. 1948.

(4) Dale, H.: Pharmacology of histamine: with brief survey of evidence for its occurrence, liberation, and participation in natural reactions. Ann. New York Acad. Sc. 50: 1017-1028, Apr. 28, 1950.

(5) Zon, L.; Ceder, E. T.; and Crigler, C.: Presence of histamine in inflammatory lesions. Arch. Path. 33: 452-459, Apr. 1942.

(6) Menkin, V.: Dynamics of Inflammation. The Macmillan Co., New York, N. Y., 1940.

(7) Duthie, E. S., and Chain, E.: Polypeptide responsible for some of the phenomena of acute inflammation. Brit. J. Exper. Path. 20: 417-429, Oct. 1939.

to produce the increased amount. Recent work has clearly shown that this rise in histamine content in inflammation and inflammatory areas is caused by degeneration of accumulated blood platelets in the increased capillary bed in these inflammatory areas. The simplest interpretation of the experiments undertaken by Zon et al. *(5)* is that the platelets bring the increased quantity of histamine to areas of inflammation.

Because of the effect of rutin (vitamin P) on capillary permeability, Raiman et al. *(8)* stated that pretreatment with rutin is effective in protecting sensitized animals against anaphylactic shock. These investigations can be correlated with the susceptibility of localized tissue such as gingival margins where there is a localized area of rutin deficiency associated with gingivitis or pocket formations. In such conditions, total destruction of cells has not taken place as is the case when tissue is destroyed by burns, acute infections, and extreme pressure from fluid exudate in severe contusions, so histamine has not been destroyed and is present to exert an effect on the tissues or the local areas. In the treatment or drainage of such inflammatory areas, histamine or the histaminelike substance is eliminated. These concepts are compatible with findings in the following case.

## CASE REPORT

A moderately well-nourished, well-adjusted, 33-year-old white woman first experienced allergic symptoms in May 1950. After a routine dental examination, at which time the teeth and periodontal pockets were examined and probed, she developed gingival tenderness, urticaria, and swelling of her hands and feet to an extent that made their use difficult. She stated also that her tongue was swollen to such extent that speech was accomplished only with some difficulty. She reported for treatment and was given amphetamine. This medication gave her some relief but caused nervousness and sleeplessness for a few days. About 1 month later she was seen in the allergy clinic where she was told that no treatment was indicated at that time inasmuch as she had been symptom-free for several weeks.

About 6 weeks later she again had urticaria and moderate swelling of the face following restoration, under local anesthesia, of the carious upper right second bicuspid. At this time she again sought treatment at the allergy clinic and was referred to the dental service for elimination of possible dental foci. It was found that she had a moderate, generalized periodontoclasia and a chronic pericementitis of the upper right second bicuspid. Treatment of the periodontal condition was begun and she reported that in the early phases of this treatment she had a rather marked exacerbation of symptoms similar to those previously described. After several treatments all symptoms disappeared and she had no further recurrence except for one mild episode about 7 months

*(8)* Raiman, R.; Later, E. R.; and Necheles, H.: Effect of rutin on anaphylactic and histamine shock. Science 106: 368, Oct. 17, 1947.

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later which developed after eating shrimp. Her swelling at this time was mild in degree, short in duration, and responded to an antihistaminic agent within a few hours.

## DISCUSSION

In the case reported injured tissues of the traumatized and inflamed areas may have liberated substances to which the patient became sensitive through the mechanism of the Burky phenomenon. The Burky phenomenon is concerned with sensitivity of a person to autogenous tissues. Action of a qualitative and quantitative bacterial toxin, in the presence of a suitable combination of factors including inflammatory processes, may foster the production of sensitive or allergic states *(9)*. Burky observed that in the process of immunizing rabbits to staphylococcus toxin, they became sensitized to the broth in which the toxin was produced. Proceeding on the theory that a broth hapten (a partial or incomplete antigen) was attached to the toxin, he attempted to produce sensitization to other substances. The protein of the crystalline lens is apparently organ specific, identical in all animals and different from the somatic protein of the animal. Attempts to sensitize animals to lens protein had heretofore been unsuccessful, but Burky grew toxin-producing staphylococci in a medium containing lens protein and following injections of this lens-toxin combination into animals, he produced sensitization to the protein of the crystalline lens. He next accomplished the same with rabbit muscle protein, sensitizing rabbits to their own muscle.

A person might become sensitive to some of his own tissue products as a result of the activity of staphylococcus or other toxins elaborated in a focus of infection or inflammation, but on testing for sensitivity with any number of pure bacterial cultures, all might be negative in spite of the fact that the toxin of one of these bacteria might have been a sensitizing agent under the influence of necessary combinations. Burky also developed the hypothesis that a sensitized animal can react to tissue cells liberated by trauma. Rabbits that had been sensitized to rabbit muscle-toxin antigen, so that they reacted positively following reinjection of this or of rabbit muscle alone, were found to react likewise to simple muscle trauma such as pinching with hemostats. If it should develop that a toxin produced in a focus of infection or inflammation can act as an antigen fraction and increase the antigenicity of ordinarily inert substances, it is conceivable that much of what we consider as nonspecific focal infection may later be shown to be specific.

## SUMMARY

A patient with allergic tendencies also had an area of inflammation and edema which was a potential source of histamine or histaminelike

*(9)* Burky, E. L.: Production in rabbit of hypersensitive reactions to lens, rabbit muscle and low ragweed extracts by action of Staphylococcus toxin. J. Allergy 5: 466-475, July 1934.

substance. Her oral inflammatory conditions consisted of: (1) an irritation of the periodontal membrane of the upper right second bicuspid caused by occlusal trauma or trauma associated with manipulation during cavity preparation (the periodontal membrane may also have been infected because the cavity extended proximally to a point under the gingival margin); and (2) a periodontitis (gingival margin inflammation and edema with pocket formation). The sensitivity of the patient to autogenous tissues, inflammatory exudate, and a nonspecific bacterial toxin may have combined to cause an allergic reaction.

# The Management of Abortion

William S. Baker, Jr., *Commander, MC, U. S. N. (1)*

ALTHOUGH the proper management of abortion has occupied the interest of many investigators, only two methods of treatment have stood the test of time, namely bed rest and sedation. Numerous other methods have been used but with no apparent benefit to the patient. Guterman and Tulsky *(2)* attempted to prove the value of pregnandiol determinations on the urine of patients who threatened to abort. In a series of 335 patients they found that 191 or 57 percent excreted normal amounts of pregnandiol and, of these, 80 percent went on to term without the addition of extra progesterone. Furthermore the remaining 43 percent excreted less than the normal amount of pregnandiol in the urine; 38 of these were given progesterone and 37 or 97 percent aborted. Of the 106 untreated patients in this group, the incidence of abortion was also 97 percent. The authors were unable to account for the poor results with progesterone but concluded that it might be of some value if given in much larger doses.

Colvin et al. *(3)* reported the outcome in a series of 1,570 patients with untreated threatened abortion: (1) 1,098 or 69.9 percent went on to term; (2) 318 or 20.3 percent aborted a blighted ovum; (3) 60 or 3.8 percent aborted products showing gross anomalies of the fetus or pathologic conditions of the placenta or membranes incompatible with viability of the fetus; (4) 32 or 2.1 percent aborted spontaneously or artificially because of toxemia, abruptio placenta, placenta praevia, or a ruptured marginal sinus threatening the safety of the mother; and (5) in the remaining 62 or 3.9 percent the cause of the abortion could not be determined. They therefore concluded that only 3.9 percent of these patients could theoretically have been benefited by a specific hormone or vitamin.

Javert et al. *(4)* reported on the treatment of primary and secondary habitual abortion. They (1) placed all patients on a diet high in citrus

*(1)* U. S. Naval Hospital, Camp Lejeune, N. C.

*(2)* Guterman, H. S., and Tulsky, A. S.: Observations on use of progesterone in threatened abortion with special reference to pregnandiol excretion as a guide to therapy. Am. J. Obst. & Gynec. 58: 495-502, Sept. 1949.

*(3)* Colvin, E. D.; Bartholomew, A.; Grimes, W. H.; and Fish, J. S.: Salvage possibilities in threatened abortion. Am. J. Obst. & Gynec. 59: 1208-1224, June 1950.

*(4)* Javert, C. T.; Finn, W. F.; and Stander, H. J.: Primary and secondary spontaneous habitual abortion. Am. J. Obst. & Gynec. 57: 878-889, May 1949.

fruits, (2) gave vitamin K, vitamin C, plus calcium and iron to all, (3) recommended complete abstinence from intercourse during the theoretical menstrual time, (4) continued ambulation of all patients, (5) applied psychotherapy, (6) gave thyroid as indicated, (7) eliminated gynecologic disease, (8) prescribed progesterone, and (9) avoided the use of mineral oil. The uncorrected abortion rate without treatment was 65 percent for the primary group and 46 percent for the secondary group. Treatment yielded a full-term salvage rate of 80 percent in the primary group and 100 percent in the secondary group. The primary abortion rate was decreased to 14 percent. Although the investigators were unable to state which vitamin, hormone, or method of treatment was responsible for the good results, the elimination of vitamins K and C and progesterone did not seem to alter the outcome.

Crowder et al. *(5)* reported on 100 patients with threatened abortion treated with massive doses of stilbestrol according to the recommendations of Karnaky and were unable to improve on the results of treatment with bed rest and sedation alone.

Seitchik *(6)* studied the pregnandiol levels of a group of pregnant women between the twentieth and thirty-eighth week of gestation while receiving stilbestrol in accordance with the regimen outlined by Smith and Smith *(7)* and was unable to determine any increase in the urinary level of pregnandiol in any of the patients. He concluded that stilbestrol administration in the latter trimester of pregnancy did *not* appear to stimulate an increased output of progesterone *as measured by urinary pregnandiol alone.*

Yanow et al. *(8)* stated that in patients with abortion not primarily caused by mechanical interference that properly determined urinary pregnandiol levels are of definite value in forecasting prognosis. They reported a correct prognosis in 93 percent of their patients.

Smith *(9)* reported on the results of treatment and prophylaxis of patients with threatened abortion in accordance with the regimen laid down by Smith and Smith *(7)*. Of 219 patients treated for threatened abortion, 78 percent carried their pregnancy to 28 weeks and 72 percent delivered live, healthy babies. The spontaneous cure rate has been reported by other investigators to be 50 percent. Abortion prophylaxis was practiced in a series of 272 patients and 83 percent carried their pregnancy to 28 weeks; of these 78 percent delivered live, healthy babies. In an

*(5)* Crowder, R. E.; Bills, E. S.; and Broadbent, J. S.: Management of threatened abortion; study of 100 cases. Am. J. Obst. & Gynec. 60: 896-899, Oct. 1950.

*(6)* Seitchik, J.: Urinary excretion of pregnandiol in pregnant women receiving diethylstilbestrol. Am. J. Obst. & Gynec. 60: 877-879, Oct. 1950.

*(7)* Smith, G. V., and Smith, O. W.: Anterior pituitary-like hormone in late pregnancy toxemia; summary of results since 1932. Am. J. Obst. & Gynec. 38: 618-624, Oct. 1939.

*(8)* Yanow, M.; Soule, S. D.; and Meyerhardt, M. H.: Sodium pregnandiol glucuronidate determinations in threatened abortion. Am. J. Obst. & Gynec. 59: 1160-1163, May 1950.

*(9)* Smith, O. W.: Diethylstilbestrol in prevention and treatment of complications of pregnancy. Am. J. Obst. & Gynec. 56: 821-834, Nov. 1948.

additional 127 patients with habitual abortion who averaged from 2 to 5 abortions, the fetal salvage rate averaged 77 percent.

Wall and Hertig (10) made a pathologic study of a series of 1,000 patients with abortion. They determined that the cause was repeated in 58 percent, 43 percent being caused by ovular factors and 15 percent by maternal factors. They concluded that each woman who miscarries is a potential habitual aborter and it is therefore important to examine pathologically the first abortus in each case thereby determining whether abortion prophylaxis would be indicated in subsequent pregnancies.

Abortion is the interruption of a pregnancy prior to the stage of viability. Based on the stage of gestation, the Lying-in Hospital of the University of Chicago places this time as prior to 22 weeks. Titus claims it to be prior to 28 weeks and the North Carolina State Board of Health Manual requires a birth certificate on all fetuses with over 20 weeks of gestation. Based on the measurements and weight of the fetus, the Chicago Lying-in Hospital's criterion for abortion is a length less than 28 cm. and a weight less than 400 grams. Javert et al. (4) stated that any fetus weighing less than 500 grams must be considered an abortion.

The *incidence* of abortion is difficult to determine accurately because of the nature of the condition and the circumstances surrounding its induction. It has, however, been estimated that from 10 to 20 percent of all pregnancies end in abortion.

Spontaneous abortion may be classified as threatened, inevitable, incomplete, and complete. A threatened abortion is characterized by uterine bleeding and uterine contractions, but no dilatation of the cervix and no passing of the products of conception. An abortion is inevitable if the bleeding is so profuse and the contractions so strong that in the judgment of the examiner the pregnancy could not be viable. An abortion is incomplete when the fetus has been expelled in whole or in part and the greater portion of the membranes have been retained. A complete abortion is one in which all the products of conception have been expelled from the uterus. The afore-mentioned types can also result from some outside initiation instead of being spontaneous. They are then classed as being induced.

Induced abortion may be either therapeutic or criminal. The former is sanctioned by society as it is performed in order to save the life of the mother. The latter is performed by the abortionist purely for monetary gain. Infection or septicemia may occur following abortion. This usually results from illegal steps taken to induce abortion. Any sustained elevation in temperature above 100.4° F. for 2 successive days should arouse suspicion of this type of abortion.

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(10) Wall, R. L., Jr., and Hertig, A. T.: Habitual abortion; pathologic analysis of 100 cases. Am. J. Obst. & Gynec. 56: 1127-1133, Dec. 1948.

Habitual abortion is usually defined as the spontaneous interruption of three or more successive pregnancies. Javert et al. *(4)* refer to the primary habitual aborter as one who has been unable to retain any of her first three pregnancies, and the secondary habitual aborter as one who has failed to retain three or more pregnancies but not in sequence.

Missed abortion is usually considered by most authorities to be the retention of the dead products of conception within the uterus for at least 2 months before they are expelled. An increase in the size of the uterus, one or more missed menstrual periods and subsequently a cessation of uterine growth will usually suggest the correct diagnosis.

The *cause* of spontaneous abortion has been the subject of intense interest by numerous investigators. Some of the more common developmental causes are: (1) blighted ovum, (2) hydatid degeneration of the trophoblast, (3) hydatidiform mole, (4) fetal monstrosities, and (5) circumvallate placenta. The endocrine system is also known to be a factor in the production of abortions. In hypo-ovarianism there is a poor response by the theca-lutein cells to the stimulating effect of the prolactin of the anterior pituitary gland. This results in a poor output of progesterone and an improperly prepared progestational endometrium. In hypopituitarism there is a deficient production or lack of pituitary gonadotropic hormone. As a result, the corpus luteum is not formed or has little secretory function. The endometrium does not develop into a progestational type. In hypothyroidism both the pituitary and ovary are inadequately stimulated and the result is a low progesterone effect on the endometrium.

After the fourteenth week of gestation the placenta is the main source of the steroid hormones. It may be unable to secrete the desired output of chorionic gonadotropin, estrogen, and progesterone, thereby producing poor endometrial response and contributing to the abortion.

Certain vitamin deficiencies have been believed to cause abortion. Javert et al. *(4)* noted a persistent low level of vitamin K and C in a series of 79 patients. Based on this fact they treated 24 of 25 patients found to be deficient in both vitamins and claimed a high incidence of success. Other investigators have stated that vitamin E is essential in the organism in order to prevent the development of fetal anomalies. This has led to the empirical use of this vitamin during the preconceptional state.

Trauma, both accidental and purposeful, has been a potent factor in the cause of abortion. Travel during the early months of pregnancy is not sanctioned by most obstetricians as it is believed to incite uterine contractions. Intercourse near or during the time of theoretical menstruation may also be a cause in some patients. The role of abortifacient liquids and pastes and of illegal dilatation and curettage needs no further comment. Miscellaneous causes of abortion include neoplasms, congenital malformations, and retrodisplacements of the uterus.

*Medicolegal aspects.*—In North Carolina criminal abortion is a felony punishable by not less than 1 year and not more than 10 years in prison plus a fine to be determined by the court. The law states in essence that the interruption of any pregnancy following a period of 30 days from the alleged impregnation at any time up until term if not performed for the benefit of the mother is an illegal abortion. Therapeutic abortion is recognized in the statutes of many States.

*Management.*—Very little can be done at the time the patient threatening to abort presents herself for treatment. Many of us who see these cases are perhaps too easily swayed by questionable and predjudiced information and order all kinds of expensive hormones, drugs, and vitamins in the desperate hope that perhaps this is the one patient who may be helped by such medication. It is necessary that we attempt to treat these patients on a more rational basis.

When a patient presents herself complaining of cramping and bleeding in the first trimester of pregnancy, I believe the following precautions should be taken: (1) make a speculum examination carefully if bleeding is profuse or within 24 hours of admission to the hospital if the patient is not bleeding heavily; (2) order complete bed rest if she has bleeding and cramping; (3) request a Friedman or Aschheim-Zondek test to determine the viability of the ovum; (4) request urinary pregnandiol determinations and if under 5 mg. per 24 hours give 25 mg. of progesterone intramuscularly every 4 hours; (5) determine the prothrombin time to reveal vitamin K deficiency; (6) give 100 mg. of vitamin C daily on an empirical basis; (7) give 100 mg. of meperidine immediately and every 4 hours until symptoms have subsided or abortion is complete; (8) allow the patient to be up if there is no bleeding after 48 hours; and (9) discharge home on Smith and Smith regimen after she has been ambulatory and asymptomatic for 24 hours.

If the abortion is incomplete it is necessary either to treat the patient conservatively or to empty the uterus by dilatation and curettage. We prefer to proceed conservatively as follows: (1) await the spontaneous emptying of the uterus and remove with ring forceps all products of conception visible in the cervical canal; (2) give one ampul of oxytocin injection followed by ½ ampul every 4 hours until a total of 4 ampuls have been given; (3) give 300,000 units of procaine penicillin b.i.d. if any signs of infection are present; (4) allow patient to be up and observe for bleeding; (5) discharge home after 24 hours if bleeding is minimal; (6) curette after 10 days if bleeding persists; and (7) examine the patient after 6 weeks to determine whether involution is complete.

If for any reason induced abortion is suspected, infection must be considered to be present. An examination for trauma to the cervix may be made and if found is strong evidence of an illegally induced abortion. Such patients should all be managed conservatively as follows: (1) obtain a statement from the patient absolving you and the hospital

from all blame; (2) order bed rest, sedation, antibiotics, and oxytocin injection if the abortion is incomplete; (3) remove any visible necrotic tissue from the cervical canal with sponge forceps; (4) culture the uterine contents and treat accordingly; and (5) consider curettage when the patient has been afebrile for 72 hours.

Patients with missed abortion should be left strictly alone. Most of them will abort spontaneously. Some benefit may be derived from giving stilbestrol in large doses for from 7 to 10 days and then withdrawing the drug. These patients should not be treated surgically unless there is undisputed evidence of a suddenly rising titer of chorionic gonadotropic hormone as measured by the Aschheim-Zondek test or the passage of portions of a mole. This would necessitate immediate emptying of the uterus by the most efficacious means possible.

The management of habitual abortion as recommended by Smith cannot at present be improved on. The phenomenal results obtained by Smith are most likely due to the fact that the treatment is started in the preconceptional stage. Smith and Smith recommend the following dosage of stilbestrol: (1) 5 mg. daily by mouth beginning at the sixth or seventh week of gestation as counted from the last menstrual period; (2) every 2 weeks increase by 5 mg. daily until the fifteenth week when 25 mg. are being taken; (3) increase weekly by 5 mg. daily until the thirty-fifth week; and (4) discontinue the drug at the thirty-fifth week.

The most important complications of abortion are (1) infection and sterility; (2) hydatidiform mole, 1 to 5 percent of which become malignant; and (3) choriocarcinoma, the incidence of which is less than 1 percent. About 25 percent of all choriocarcinoma have followed an abortion *(11)*. For this reason many obstetricians believe that curettage is the only method of treatment of incomplete abortion. According to Novak *(12)* the incidence of choriocarcinoma is so low that curettage as a routine measure is unjustified because permanent damage may be done to the endometrium and result in lasting sterility.

## SUMMARY

Progesterone is believed to be of questionable value in the treatment of about 4 percent of all threatened abortions and should only be given to patients who excrete less than the normal urinary pregnandiol as determined by the Guterman test. Vitamin K should be given only in the presence of a prolonged prothrombin time. Vitamin C may be of some benefit by providing a healthier endometrial implantation site and should be given on an empirical basis. Habitual abortion is best treated by giving stilbestrol in accordance with the regimen of Smith and Smith.

*(11)* Siegler, S. L.; Ravid, J. M.; and Tobin, S. M.: Appraisal of chorionepithelioma based on observations in 12 cases. Am. J. Obst. & Gynec. 60: 586-604, Sept. 1950.

*(12)* Novak, E.: Gynecological and Obstetrical Pathology; With Clinical and Endocrine Relations. W. B. Saunders Co., Philadelphia, Pa., 1941. pp. 422-446.

Dilatation and curettage should not be resorted to in the treatment of incomplete abortion until after a 10-day trial of conservative management because permanent sterility is sometimes the unwelcome sequela of such an act and the incidence of choriocarcinoma is too small to justify it. Bed rest and sedation are still the most important elements in the treatment of abortion and newer methods of treatment have not succeeded in lowering the yearly incidence.

# Betel Nut Chewer's Cancer[1]

Ralph W. Mendelson, *Colonel, U. S. A. F. R. (MC)*

CANCER of the oral tissues is a not uncommon condition in people who chew betel nut. The existence of these cancers and their associated cause have been known for many years. The custom of chewing betel nut prevails throughout the tropical Far East and is much more pernicious than the chewing of tobacco. The "cud" is made of betel nut with a small amount of slaked lime wrapped in the leaf of the betel palm. It is a very pungent, astringent, and slightly stimulating mixture. According to Webster's Unabridged Dictionary, the nut proper contains, beside tannin, the following alkaloids, all of which are pyridine derivatives: (1) arecoline, the methyl ester of arecaidine, a poi-

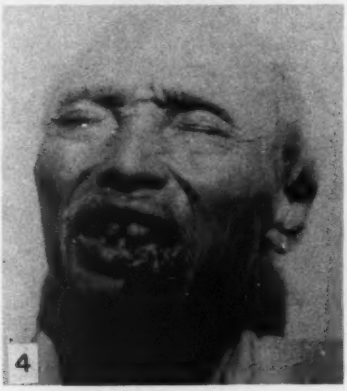
*Figure 1. Teeth of betel nut chewer.*

sonous liquid to which medicinal properties have been ascribed; (2) arecaidine *(2)*, a nontoxic crystalline acid; (3) arecolidine, a crystalline isomer of arecoline; (4) arecaine *(2)*, a crystalline methyl derivative of guvacine; (5) guvacine, a crystalline substance; and (6) guvacoline, the crystallizable methyl ester of guvacine.

Continued use of the "cud" results in retraction of the gums, severe pyorrhea and loosening of the teeth which become stained an ebony black (fig. 1). The mechanical irritation from the protruding teeth and

*(1)* From a study made in Siam when the author was Medical Adviser to the Royal Siamese Government.

*(2)* Editor's note: According to the United States Dispensatory, 24th edition, arecaidine and arecaine have been shown to be identical.



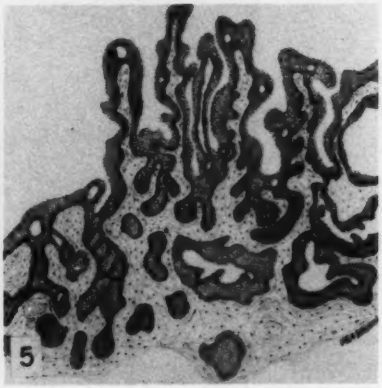
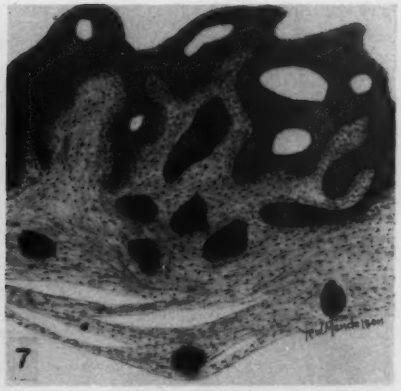




*Figure 2. Papilloma of lip in betel nut chewer. Figure 3. Drawing of cross section of lesion shown in figure 2. Figure 4. Carcinomatous degeneration of papilloma of lip in betel nut chewer. Figure 5. Drawing of cross section of lesion shown in figure 4.*



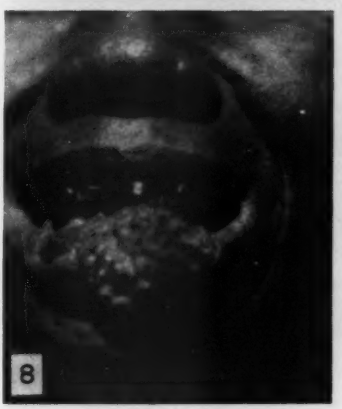



*Figure 6. Carcinomatous degeneration of papilloma of lip and metastatic growth in cheek in betel nut chewer. Figure 7. Drawing of cross section of lesion shown in figure 6. Figure 8. Carcinomatous degeneration of papilloma of lip in betel nut chewer. Figure 9. Drawing of cross section of lesion shown in figure 8.*

the chemical effect of the betel nut mixture seem to be the determining factors in the production of a malignant neoplasm of the oral tissues. Primarily the growths are papillomatous in character (figs. 2 and 3) later becoming malignant (figs. 4-13). Although one of the alkaloids, arecoline, is supposed to possess antimycotic properties, many betel nut users suffer from a mycotic infection of the lips (fig. 14). A fungus may be obtained from the cud that is identical with that found in the lesions. Furthermore, treatment of the skin lesions is of no avail unless the patient ceases to chew betel nut.

I seldom saw a patient in the early stage of his disease and, unfortunately, most of them had been treated by native healers with a variety of irritating applications. Those with papillomatous growths only were successfully treated but were reluctant to accept the chewing of betel nut as the cause of their disease. Betel nut cancer is a striking ex-

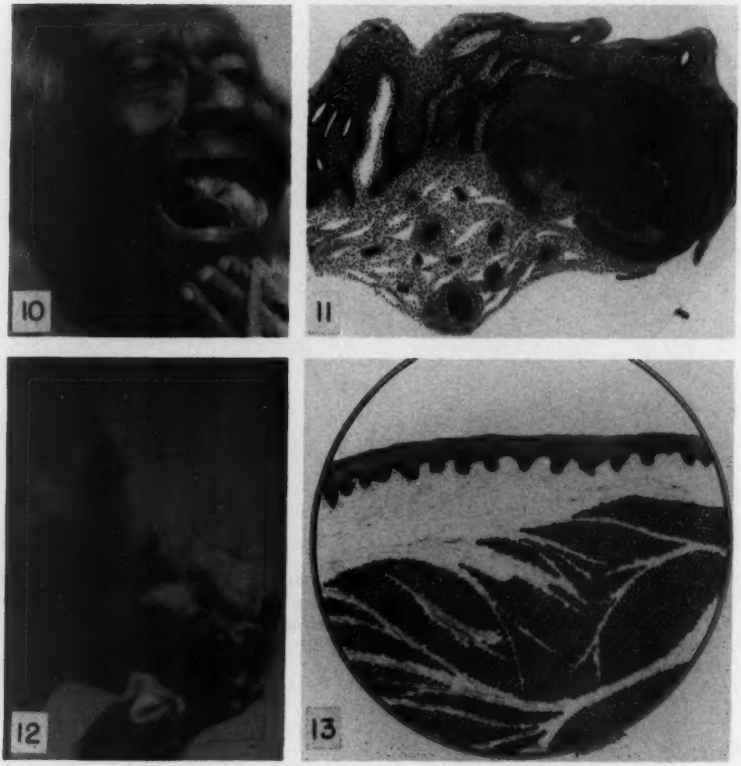



*Figure 10. Carcinomatous degeneration of papilloma of tongue in betel nut chewer. Figure 11. Drawing of cross section of lesion shown in figure 10. Figure 12. Endothelial sarcoma of tongue in betel nut chewer. Figure 13. Drawing of cross section of lesion shown in figure 12.*

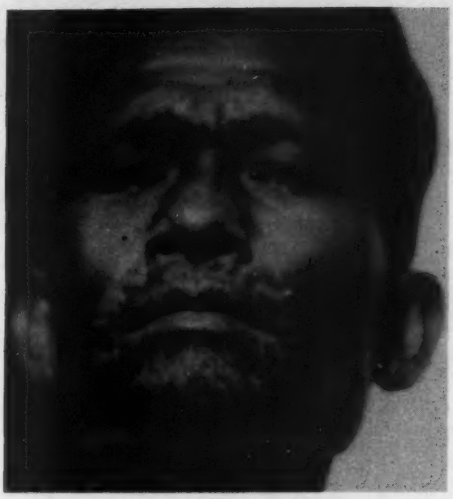


*Figure 14. Mycotic infection of lips in betel nut chewer.*

ample of a malignancy caused by self-inflicted and preventable irritation which is difficult to control because of the nature of the habit underlying the cause.

Editor's note: Davis *(3)* reported on betel nut cheek cancer as observed at the Philippine General Hospital, Manila. In 49 patients with cheek cancer he found that 81 percent chewed betel nut. The site of the growth corresponded to the position in which the cud was held. Spittel, Davidson, and Turner *(4)* have shown that cancer of the cheek is the most common malignant growth in Ceylon. They believed it to be due to the irritation caused by betel chewing. Bentall *(4)* stated that cheek cancer is common in Travancore, South India, where betel nut chewing is widely practiced, and that out of 1,700 patients with this form of cancer, 70 percent chewed betel nut.

*(3)* Davis, G. G.: Buyo cheek cancer with special reference to etiology. J. A. M. A. 64: 711-718, Feb. 27, 1915.

*(4)* Cited by Manson-Bahr, Sir P. H., in Manson's Tropical Diseases. 13th edition. The Williams & Wilkins Co., Baltimore, Md., 1950. chap. 2, p. 33.

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# Foreign Bodies in the Lip

J. P. Echtemach, *Lieutenant Commander, DC, U. S. N. R.*

FOREIGN bodies in the soft tissue around the oral cavity are frequently encountered following traumatic injuries resulting from accidents and combat casualties. It is advisable to explore thoroughly, by means of probe, palpation, or radiographs, lacerated areas of the face when the patient is first seen. The following case report illustrates one of these complications, which easily may be overlooked by even an experienced examining officer.

## CASE REPORT

Examination of the oral cavity of a 24-year-old man revealed an excessive swelling of the lower lip and two hard masses 4 mm. to the left of the median line in the fleshy structure of the lower lip. The area was tender when palpated or when the lip was pressed against the lower incisor teeth. The incisal third of the upper left central incisor was completely fractured (fig. 1) as a result of an automobile accident

*Figure 1. Roentgenogram showing defect in the upper left central incisor.*

*Figure 2. Roentgenogram of lower lip showing superimposed foreign bodies.*

2 weeks earlier. Signs of a laceration which had healed with no apparent complication were noted on the vermilion surface of the lower lip adjacent to the left incisor teeth. A dental radiograph of the area (fig. 2) clearly showed the two fragments of the upper central incisor, superimposed on each other, imbedded in the fleshy structure of the lower lip.

Under local anesthesia an incision, 1 inch in length, was made on on the internal surface of the lip, care being taken not to incise the external vermilion surface. This method of entry into the fleshy tissue avoided the formation of a disfiguring scar on the normally visible ex-

ternal surface. The fragments were readily removed and the incision closed.

## COMMENT

Minor surgical operations such as this can be readily performed by the dental officer in the dental operating room, but a more thorough examination at the time this patient was seen, immediately after injury, would have led to the discovery and removal of the fragments and would have obviated the later procedure.

# A Volunteer Blood Donor Program[1]

John A. Mikuluk, *Lieutenant Colonel, MSC, U. S. A.*

BECAUSE whole blood has become a vital item in the treatment of patients in our general hospitals, the commanding general of the Army Medical Center decided that a volunteer blood donor program should be handled by the Center in cooperation with the American Red Cross, instead of being an integral part of the Red Cross program. This decision placed a grave responsibility on Army Medical Center personnel. A committee was appointed to work out the details of the program. This committee consisted of the commanding general as chairman, the executive officer of the Army Medical Service Graduate School, the troop commander, a representative of the Army Nurse Corps, the chief of the manpower analysis branch, the executive officer of the Army Prosthetics Research Laboratory, and an information specialist experienced in publicity technics. With the exception of the information specialist the committee represented the principal groups that make up the Center.

Although other Armed Forces' installations in the area are served by the Center's blood bank, the committee's task was limited to a program for donations from personnel of the Center. At the first committee meeting we started by thinking in terms of the familiar annual campaigns for funds, but it was soon recognized that a campaign for donations of blood each week, every week, throughout the years would require a different approach. For one thing an excess of donors one week would probably be more of a liability than an asset. Consequently we divided the Center's personnel into groups, each group under the leadership of a "keyman," as in other campaigns. Because success depends largely on the effective follow-up of keymen, these were carefully chosen from the standpoint of leadership. They were also people in positions to command the attention of those in their groups. At first we thought it would be better to divide personnel into groups of equal numbers in order to make the competitive standing of the different groups more obvious, but we finally decided that group pride would work more effectively by the division into groups following functional

(1) Army Medical Center, Washington, D. C.

lines. This meant that some groups were much larger than others. In order to highlight the competitive aspect, each group was assigned a weekly quota based on its numerical strength. A box score chart showing which groups were meeting their weekly and accumulated quotas, and which were not, was designed.

Fixing the quota for each group was complicated by the differences in the size of the groups. We had a fixed target—an estimated need of 35 pints of blood a week from Center personnel. This worked out to 1 person in each 100 being required to give 1 pint each week. Troop command, our largest group, has a quota of 10, and consistently goes *over* its quota every week. The smallest group contains only 5 members, and could meet its quota with a donation of 1 pint every 20 weeks. The odd numbered groups were harder to figure. The School group, for example, has 284 potential donors, making a weekly quota of 2.84 pints. This works out to a quota of 3 pints a week for 6 weeks, 2 pints for the following week in recurring cycles of 7 weeks. Although the periodic change in quota is not desirable, the advantages of having groups that consist only of those who work together and can be expected to feel a 'team spirit' outweigh the disadvantages.

We now believe that several of the smaller groups should be combined, so that contributions from each group will be fairly frequent. The fact that the group of 5 is behind in its small quota seems to indicate that an obligation due only every 20 weeks is likely to be overlooked.

For purposes of concentrating our efforts, one day (Tuesday in this instance) was picked as Army Medical Center day at the blood bank. The blood donor center is open during designated hours in the morning and afternoon, and for 2 hours in the evening. Although donors from the Center may give at any time on any day the blood donor center is open, Tuesday gives us a focal point during the week on which to fix attention, but, a donor's group is credited with his donation regardless of the day he contributes.

The question of recognition for donors was considered especially important in view of the recent decision of the Department of Defense to eliminate payment for blood donors. Regular donors accustomed to being paid would probably continue to donate for purely humane reasons, but we believed it would be easier to maintain their cooperation if the moral satisfaction which must now replace the former cash reward could be reinforced with tangible recognition of contributions. In addition to the Red Cross blood-drop pin and a card noting the blood type and dates of contributions, it was decided to add a personal letter of recognition from the commanding general to those donating more than once, and to publish the list of donors each week in the Center's newspaper as part of the publicity program.

The organization set up to insure the continued working of the program is headed by the commanding general, and includes a supervisory committee, which presently consists of members of the original survey committee (membership will be changed periodically in order to spread the work); the keymen of the various groups; the Red Cross and military personnel of the blood bank; and the publicity director who works with the full cooperation of the Center's newspaper. The committee believed that one of the most important factors in the success of the program was getting a key man or woman to take charge of the program at each level. The commanding general heads our program, signs the directives and the letters of recognition, and occasionally addresses meetings of the key personnel. The keymen are really what the name implies. With initial impetus and continuing support from the commanding general, it is up to them to sustain the momentum week after week and month after month.

To keep the blood flowing into the bank at a steady pace after the first enthusiasm has worn off, we have found the most effective tools are charts kept by the keymen. If each keyman has a roster of his potential donors and a record of when they have contributed, he is in a position to remind those who have not given blood as well as those whose second donation is due. He knows just where to look for volunteers. Also, he has a record of any in his group who, for one reason or another, are not able to contribute. We find that the keymen who keep such records for their own guidance are much more dependable than those who just look at the calendar each week and try to round up their quota of volunteers without knowing accurately who has already donated or when. Record keeping is vital, not only at the keyman level, but at the blood bank and in the publicity department. Nothing dampens the enthusiasm of a donor more thoroughly than having his name omitted from the week's honor list and nothing ruins the morale of a group and its keyman faster than having another group get credit for its donors. Even misspelling a donor's name in the published list may affect his determination to come back and give another pint of blood a few months later.

The blood bank personnel are important, too. Their attitude, sympathetic and cheerful or otherwise, has a tremendous effect, especially on those donating blood for the first time. Military personnel are assigned to the blood bank staff, with volunteer Red Cross workers manning the canteen and keeping the records. From the beginning the military personnel have been an asset to the program by encouraging donors and taking pains to explain the process "beyond the actual call of duty." The volunteer Red Cross workers have been as efficient and helpful as if it were one of the Red Cross's own blood centers, and their willing cooperation has made the job much easier.

The Medical Illustration Section made up a large chart to hang in the blood bank, showing the weekly and cumulative standing of the various groups. The score on this chart is published each week in the post newspaper for all to see. The Medical Illustration Section also worked out an effective exhibit for the School group (fig. 1) in which

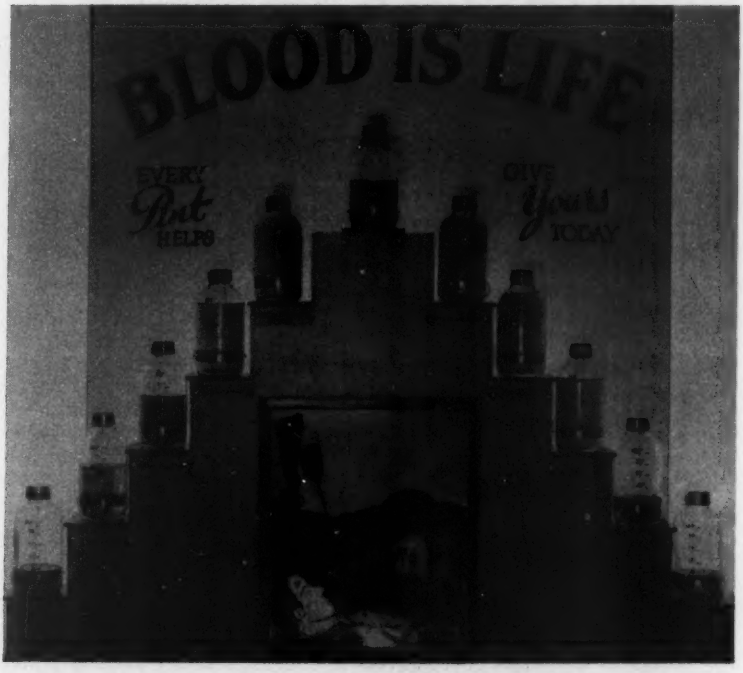


*Figure 1.*

the level of red fluid in blood-collecting bottles labeled with the names of the different sections in the School is raised as each section meets its quota.

Besides publication of the weekly and cumulative score chart, publicity has included a short news story in the Center's newspaper each week, which serves as the lead for the week's honor list. A photograph of an outstanding donor, a group that has volunteered in a body, or a distinguished visitor who stops in to give blood, is included as often as possible, and occasionally a dramatic new picture of blood being administered on the battle field or a shipment of whole blood to Korea. Sometimes, the story is of a human-interest incident at the bank, sometimes a personality piece about one of the donors. Occasionally we use a short informational piece on blood types and typing and why they are important; on the place of the new plasma

expanders in saving lives emphasizing that they do not take the place of whole blood; or we can use this space to compliment a group that is doing well. On occasion, we use a short humorous article.

Far more important than the general publicity is the element of personal contact. News stories and pictures, honor rolls and letters of thanks can not take the place of the keyman who knows how long it has been since each member of his group donated blood, and who is sincerely concerned with getting the right number of donors to report each week. The generalized work can create an atmosphere of acceptance toward the blood bank, but it's the personal follow-up that actually brings the donors to the bank.

Any program of this kind must be adapted to local conditions. Many of the details of our program would not apply elsewhere, and, indeed, we are constantly modifying them here, but the main features as outlined above can perhaps serve as a guide for others setting up similar programs.

# Coarctation of the Aorta

James H. Forsee, *Colonel, MC, U. S. A. (1)*
Henry W. Swan, II, *M. D. (2)*
Edwin M. Goyette, *Colonel, MC, U. S. A. (1)*
Harry P. Makel, *Major, MC, U. S. A. (1)*

THE nation's increasing demands for conservation of manpower requires the retention of young men and women in the military service, and reconsideration may well be given to the question of certain congenital cardiovascular defects which have occasionally been the cause for separation from the Armed Forces. The correction of the adult type of coarctation of the aorta by surgical means should permit a person to perform full military duties and should alter the previously unfavorable prognosis for normal longevity. Persons of military age suffering from coarctation of the aorta are easily detected by noting the presence of an elevated blood pressure in the upper extremities and the absence or weakness of arterial pulsations with a decreased or absent blood pressure in the lower extremities. Arterial angiography is an adjunct in the diagnosis of this condition. The condition is usually correctable in young adults, and patients are thereby restored to full physical fitness for military duty. Three patients treated during recent months are briefly reported.

## CASE REPORTS

*Case 1.*—A robust 17-year-old student at an Air Force Training School complained of repeatedly going to sleep while attending classes. He was a high school graduate but had not participated in athletics as his family physician had advised against such activities because of high blood pressure. A thorough clinical investigation revealed full and bounding radial pulsations; brachial blood pressure between 190/100 and 150/100; impalpable femoral pulsations; and no audible blood pressure in the right leg and in the left leg a feeble but audible pressure of 100/80. The heart sounds were easily heard throughout the left thorax and a grade II systolic murmur was present. Visible pulsations were noted on the chest wall in the region of the tenth rib. Roentgenograms revealed notching of the under-surface of the left fifth and sixth and the right sixth and seventh ribs. Angiocardiography was unsatisfactory. A diagnosis of coarctation of the aorta was made and an operation per-

(1) Fitzsimons Army Hospital, Denver, Colo.
(2) Department of Surgery, Colorado Medical School, Denver, Colo.

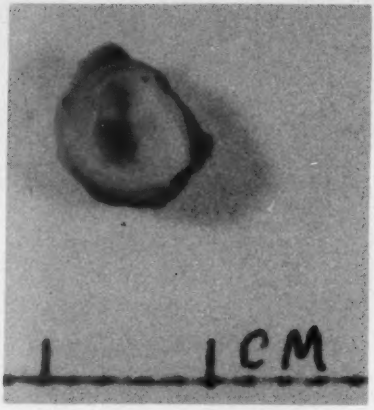


*Figure 1.—Lumen of resected aorta showing coarctation.*

formed. The coarctated area was about 7.5 mm. long. The aorta both proximal and distal to the coarctated area was appreciably narrowed. The subclavian artery was quite large and anastomosing it to the aorta was considered, but this was not done. The coarctated area was resected and the two ends of the aorta sutured after the methods of Crafoord and Nylin *(3)* and Gross *(4)*. The lumen of the coarctated area was constricted to a diameter of only 1.2 mm. (fig. 1). The new opening resulting from the anastomosis of the two ends of the aorta was 1 cm. in diameter. The postoperative course was uneventful. The patient noted a definite increase in the warmth of his lower extremities. The postoperative brachial blood pressure was 140/80 and in the lower extremities was 110/84. The patient returned to full military duty and a favorable prognosis as to longevity is predicted.

*Case 2.*—A 29-year-old man who had been in the military service for 10 years had been hospitalized 7 times in that period and had received medical attention on several other occasions for minor illnesses and injuries. He had been examined for re-enlistment twice, treated by private physicians because of high blood pressure, and his application for life insurance had been rejected by a commercial company. He was admitted to Fitzsimons Army Hospital in June 1950. For 3 years prior to admission he had intermittent, severe headaches lasting from 6 to 12 hours and often associated with nausea. In October 1949 he fainted while engaged in moderately strenuous work. His blood pressure was equal in both arms and varied from 160/90 to 190/110. There was a systolic cardiac murmur. The blood pressure was not audible in either leg. Electrocardiograms revealed first degree atrioventricular block and defective intraventricular conduction. Roentgenograms of the chest revealed notching of the third to fifth ribs on the left. The retinal vessels were tortuous with increased light reflexes. A diagnosis of coarctation of the aorta was made. He underwent surgical excision of the coarcted area and an end-to-end anastomosis of the aorta on 27 June. A section of the aorta 1 cm. long was removed. The lumen of the excised vessel tapered abruptly to a slit-like orifice with a patency which

(3) Crafoord, C., and Nylin, G.: Congenital coarctation of aorta and its surgical treatment. J. Thoracic Surg. 14: 347-361, Oct. 1945.

(4) Gross, R. E.: Discussion of motion picture presentation on "Surgical Treatment of Coarctation of the Aorta" by Dr. Clarence Crafoord. J. Thoracic Surg. 16: 256-257, 1947.

could not be demonstrated without trauma to the tissues. The postoperative course was uneventful. Postoperative blood pressure in the lower extremities varied from 110/70 to 120/80 and the femoral arterial pulsations were forceful. The patient returned to full military duty with the military police. The determination of the blood pressure in the lower extremities earlier in his career would doubtless have revealed information leading to the diagnosis of coarctation of the aorta.

*Case 3.*—A 19-year-old soldier was hospitalized in Germany in March 1950 because of an acute upper respiratory infection. Physical examination revealed a brachial blood pressure of 180/94 bilaterally, a loud systolic murmur heard over the entire anterior portion of the chest, no audible blood pressure in lower extremities, indistinct pulsations of the femoral vessels, and absence of pulsations in the popliteal and ankle areas, bilaterally. The ECG was normal. Roentgenograms of the chest revealed notching of the left fourth and fifth ribs. Because of these findings, a clinical diagnosis of coarctation of the aorta, adult type, was made and the patient was transferred to Fitzsimons Army Hospital for operation. The aorta was found to be markedly constricted an inch below the junction with the left subclavian artery which was markedly enlarged. The coarctated area was excised and an end-to-end anastomosis of the aorta performed. The internal diameter of the coarctated area was less than 2 mm. Femoral pulsations were easily palpable immediately after operation and the postoperative blood pressure in the lower extremities was 140/105 and in the upper extremities was 140/95 bilaterally. Popliteal and dorsalis pedis arterial pulsations were easily felt. The patient returned to full military duty and participated actively in sports. This case report illustrates the ease with which the diagnosis of the adult type of coarctation of the aorta can be made.

## SUMMARY

Coarctation of the aorta is occasionally encountered in military personnel. The diagnosis is easily made if the blood pressure is taken in all extremities in young adults with hypertension. The surgical correction of this defect permits the patient to perform full military duty, altering an unfavorable prognosis as to longevity to normal.

# A Foot By-Pass Apparatus for Treating Fractures of Femur

August W. Spittler, *Colonel, MC, U. S. A.*
John J. Brennan, *Lieutenant Colonel, MC, U. S. A.*

OUR purpose in this article is to present an apparatus to improve the treatment of fractures of the femoral shaft with skeletal traction. This is accomplished by the use of a metal ring placed in the line of traction over the foot. This causes the traction to by-pass the foot. This apparatus has been used by the senior author

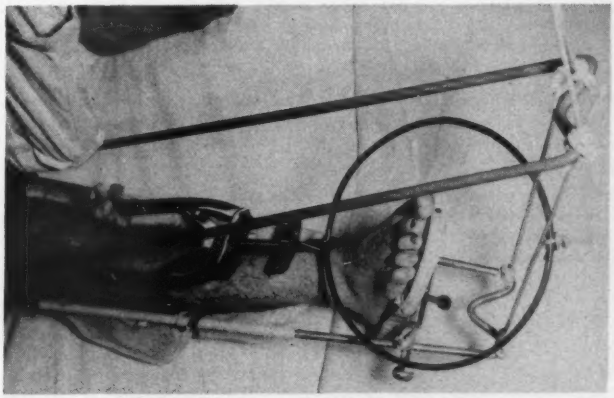

*Figure 1. Foot by-pass apparatus in use.*

since 1937. Its use has permitted traction to be employed in the long axis of the femur with the knee extended. This is an important feature as we believe that in treating fractures of the femur by skeletal traction the knee extension should be accomplished as soon as possible.

The apparatus consists of a metal ring which is constructed in the brace shop of one-quarter inch cold rolled steel shaped and welded into a circle. Rings 7 and 10 inches in diameter are made and stocked with the orthopedic equipment. Rectangular and triangular shapes have been tried but have no advantage.

After the usual skeletal traction is set up the ring is attached by a hook to the handle of the Kirschner wire tractor in such a manner as to encircle and clear the extended foot and the lower overhead suspension ropes of the splint. A rope passes to the traction pulley (fig. 1). When the healing of the fracture warrants change in knee position, the transition to extension from the flexed position of the knee is accomplished with ease. The foot clears the apparatus and the direction of pull of the traction rope need not be altered to clear the foot. It is impossible for the foot to strike the rope and discomfort to the patient is avoided.

Early institution of knee movement by conversion of the Pearson attachment to an exerciser is facilitated by the use of the metal ring by-pass of the foot. It helps prevent ankylosis of the knee. The patient is able completely to extend the knee with full clearance for the foot at any time. Using full extension of the knee as the resting position in the intervals between the exercise periods is also facilitated by the use of the ring. Conventional positional foot splints to prevent equinus contracture can readily be used with the metal ring.

# BOOKS RECEIVED

**Administrative Housekeeping,** by *Alta M. La Belle,* Consultant on Housekeeping and Interior Design, Former Director of Housekeeping, Michael Reese Hospital, Chicago, and *Jane Barton,* Associate Editor, The Modern Hospital. 420 pages; illustrated. G. P. Putnam's Sons, New York, N.Y., publishers, 1951. Price $5.

**The Diagnosis and Treatment of Adrenal Insufficiency,** by *George W. Thorn,* M.D., M.A. (Hon.), LL.D. (Hon.), Hersey Professor of the Theory and Practice of Physic, Harvard Medical School and Physician-in-Chief, Peter Bent Brigham Hospital, Boston, Mass., with the collaboration of *Peter H. Forsham,* M.D., M.A. (Cantab.), Instructor in Medicine, Harvard Medical School and Junior Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass.; and *Kendall Emerson, Jr.,* M.D., Assistant Professor, Harvard Medical School and Senior Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass. 2d edition. 182 pages. Publication Number 29, American Lecture Series. A Monograph in American Lectures in Endocrinology. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $5.50.

**Annual Review of Medicine,** Volume 2, by *Windsor C. Cutting,* Editor, Stanford University School of Medicine, and *Henry W. Newman,* Associate Editor, Stanford University School of Medicine. 485 pages. Annual Reviews, Inc., Stanford, Calif., publisher, 1951. Price $6.

**Chest X-ray Diagnosis,** by *Max Ritvo,* M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; Roentgenologist-in-Chief and Director, Department of Radiology, Boston City Hospital; Associate Radiologist, Beth Israel Hospital, Boston, Mass.; Radiologist, Jewish Memorial Hospital, Jewish Tuberculosis Sanitorium of New England, Revere Memorial Hospital, and Hudson Hospital. 558 pages; 615 illustrations. Lea & Febiger, Philadelphia, Pa., publisher, 1951. Price $15.

**An Introduction to Modern Psychology,** by *O.L. Zangwill.* 227 pages; 20 illustrations. Philosophical Library, New York, N.Y., publisher, 1950. Price $3.75.

**Adventure in Mental Health, Psychiatric Social Work with the Armed Forces in World War II.** A Symposium by: *Betty P. Broadhurst, Irving Brodsky, Elwood W. Camp, Almena Dawley, Ethel L. Ginsburg, Irving Greenberg, Frank T. Greving, Sidney Hechter, Alfred J. Kahn, Henry S. Maas, Daniel E. O'Keefe, Daniel L. Prosser, Myron J. Rockmore, Elizabeth H. Ross, Forrest H. Whitney,* and *Imogene S. Young.* Edited by *Henry S. Maas.* 334 pages. Columbia University Press, New York, N.Y., publisher, 1951. Price $4.50.

**Army Medical Library Classification, Medicine.** Preclinical Sciences–QS-QZ, Medicine and Related Subjects–W. 1st edition. 275 pages. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 1951. Price $1.25.



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**Roentgen Manifestations of Pancreatic Disease**, by *Maxwell Herbert Poppel*, M.D., F.A.C.R., Associate Professor of Clinical Radiology, New York University, Bellevue Medical Center; Associate Roentgenologist, New York University Hospital; Associate Radiologist, Mount Sinai Hospital; Roentgenologist, Welfare Island Dispensary, New York City; Consultant in Radiology, United States Naval Hospital, St. Albans, Long Island, N.Y.; Attending Consultant in Radiology, United States Veterans' Administration Hospital, Bronx, N.Y.; Commander, MC, U.S.N.R. 389 pages; illustrated. Charles C Thomas, publisher, Springfield, Ill., 1951. Price: $10.50.

**The Neuroses, Diagnosis and Management of Functional Disorders and Minor Psychoses**, by *Walter C. Alvarez*, M.D., Professor of Medicine, Emeritus, Mayo Foundation, University of Minnesota; Emeritus Consultant in Medicine, the Mayo Clinic. 667 pages. W.B. Saunders Co., Philadelphia, Pa., publisher, 1951. Price $10.

**Treatment of the Nephrotic Syndrome**, by *Lee E. Farr*, M.D., Chairman, Medical Department, Brookhaven National Laboratory; Physician-in-Chief, Brookhaven National Laboratory Hospital, Upton, Long Island, N.Y. Publication Number 64, American Lecture Series. A monograph in American Lectures in Circulation. 61 pages. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $1.75.

**Lane Medical Lectures: Companionship of Water and Electrolytes in the Organization of Body Fluids**, by *James L. Gamble*, Emeritus Professor of Pediatrics, Harvard Medical School. Stanford University Publications University series, Medical Sciences, Volume V, Number 1. 90 pages; 42 illustrations. Stanford University Press, Stanford, Calif., publisher, 1951. Price $2.50.

**Anesthesia in General Practice**, by *Stuart C. Cullen*, M.D., Head of Division of Anesthesiology, Department of Surgery, State University of Iowa Hospitals; Professor of Surgery (Anesthesiology), State University of Iowa College of Medicine. 3d edition. 292 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1951. Price $4.50.

**Endoscopy, As Related to Diseases of the Bronchus, Esophagus, Stomach, and Peritoneal Cavity**, by *Edward B. Benedict*, A.B., M.D., F.A.C.S., Assistant Clinical Professor of Surgery, Harvard Medical School; Endoscopist, Massachusetts General Hospital, Boston, Massachusetts. 373 pages; illustrated. The Williams & Wilkins Co.,-Baltimore, Md., publisher, 1951.

**Practical Clinical Psychiatry**, by *Edward A. Strecker*, A.B., A.M., ScD., Litt.D., LL.D., M.D., Professor of Psychiatry, School of Medicine, University of Pennsylvania; *Franklin G. Ebaugh*, A.B., M.D., Professor of Psychiatry, University of Colorado, School of Medicine; Director, Colorado Psychopathic Hospital; and *Jack R. Ewalt*, M.D., Professor of Neuro-Psychiatry; Administrator of Hospitals, University of Texas Medical Branch, Galveston, Texas. Section on Psychopathologic Problems of Childhood, by *Leo Kanner*, M.D., Associate Professor of Psychiatry, Johns Hopkins University School of Medicine. 7th edition. 506 pages; illustrated. The Blakiston Co., Philadelphia, Pa., publisher, 1951. Price $7.

# BOOK REVIEWS

**Bases of Human Behavior, A Biologic Approach to Psychiatry,** by *Leon J. Saul,* M.D., Professor of Clinical Psychiatry, University of Pennsylvania School of Medicine; Psychiatric Consultant, Swarthmore College; Lecturer, Bryn Mawr College. 150 pages; illustrated. J.B. Lippincott Co., Philadelphia, Pa., publishers, 1951. Price $4.

This book should be required reading for those who wish to understand their patients whether medical, surgical, or psychiatric. Because "every disease and every disorder occurs in a human being who is tense with emotion," the physician who is aware of this but not really certain of how the emotions disturb the personality or what part emotions play in both physical and mental disease, can, in one evening of pleasurable reading, re-acquaint himself with the important biologic and physiologic principles underlying human behavior. Dr. Saul skillfully blends the contributions, discoveries, and research findings of our outstanding men of science and medicine in a way that places the new science of psychodynamics on a firm foundation. The work of such men as Cannon, Pavlov, Sherrington, Virchow, Selye, Wolf, and others is so integrated as to form a concept of the whole person that will interest even the most organically minded physician.

Dr. Saul writes vividly and illustrates biophysiologic facts with highly pertinent examples from life, literature, poetry, and aphorisms that combine to make this book highly entertaining reading. His condensation of material prevents a detailed exposition of the proof for many facts presented pragmatically and dogmatically. For the busy practitioner, this may be advantageous. Those who want to delve deeper should read the same author's "Emotional Maturity."

—*Lt. Col.* L. E. Gatto, *U.S.A.F. (MC)*

**Annual Review of Physiology,** by *Victor E. Hall,* Editor, Stanford University; *Jefferson M. Crismon,* Associate Editor, Stanford University; and *Arthur C. Giese,* Associate Editor, Stanford University. Volume XIII. 457 pages. Annual Reviews, Inc., Stanford, Calif., publishers, 1951. Price $6.

In a prefatory chapter Dr. Carl J. Wiggers reviews physiologic concepts held between 1900 and 1920 giving an account of his participation in the changes which have evolved. In this chapter many of the important contributions of physiology and the part played by the outstanding men of the late nineteenth and early twentieth centuries are traced.

The book is international in scope in that the contributors come from the United States, England, Italy, Sweden, and France. All phases of physiology are covered. This manual is not for the average practitioner but is needed in teaching institutions and medical libraries. The bibliography is extensive and reveals the wide search made by the contributors to cover their subjects.—*Commander* G. M. Kahn, MC, U. S. N.

**The Diagnosis and Treatment of Adrenal Insufficiency**, by *George W. Thorn*, M.D., M.A. (Hon.), LL.D. (Hon.), Hersey Professor of the Theory and Practice of Physic, Harvard Medical School; and Physician-in-Chief, Peter Bent Brigham Hospital, Boston, Mass.; with the collaboration of *Peter H. Forsham*, M.D., M.A., (Cantab.), Instructor in Medicine, Harvard Medical School and Junior Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass., and *Kendall Emerson, Jr.*, M.D., Assistant Professor, Harvard Medical School and Senior Associate in Medicine, Peter Bent Brigham Hospital, Boston, Mass. Publication Number 29, American Lecture Series. A Monograph in American Lectures in Endocrinology. 2d edition. 182 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $5.50.

This new edition contains 21 more pages than the first edition and the chapter on chemical experience in the use of synthetic cortisone acetate has been rewritten. The chapters on types of adrenal cortical insufficiency and laboratory findings are comprehensive and practical. Dr. Thorn discusses the indications for the use of ACTH.

—*Col.* F. W. Pruitt, *MC, U.S.A.*

**Correlative Neuroanatomy**, by *Joseph J. McDonald*, M.S., M.Sc. D., M.D.; *Joseph G. Chusid*, A.B., M.D.; and *Jack Lange*, M.S., M.D. 5th edition. 180 pages; 70 illustrations. University Medical Publishers, Palo Alto, Calif., publishers, 1950. Price $3.

Previous editions of this manual have served a useful purpose for medical students and others who wish a quick, dogmatic survey of the field of neuroanatomy. In the present edition the authors have attempted a survey of basic neurology in outline form with the aid of diagrams. The book is divided into three main sections: peripheral and cranial nerves, principles of neurodiagnosis, and diseases of the nervous system. As an outline for a review of basic principles it should be useful to medical students. It should stimulate the reader to fill in the many gaps which are necessarily present by recourse to the more comprehensive texts. The section on cranial and peripheral nerves is better than the remaining portions of the book, probably because these suffer less from this condensed type presentation.

—*Lt. Comdr.* R. G. Berry, *MC, U.S.N.*

**Cancer as I See It**, by *Henry W. Abelmann*, M.D. 100 pages. Philosophical Library, Inc., New York, N.Y., publishers, 1951. Price $2.75.

This brief but rambling discussion of cancer with its attempt to establish the infectious origin of malignancy contains little or nothing to recommend it either to the laity or to the medical profession. In pre-

senting his one-sided interpretation of cancer research data, the author has included many inconsistencies and errors in the application of logic and analogy.— *Lt.* E. S. Redfield, *MC, U.S.N.*

**Surgical Forum, Proceedings of the Forum Sessions, Thirty-sixth Clinical Congress of the American College of Surgeons, Boston, Mass., October, 1950.** Surgical Forum Committee, *Owen H. Wangensteen,* M.D., F.A.C.S., Minneapolis, Chairman; *Warren H. Cole,* M.D., F.A.C.S., Chicago; *Robert E. Gross,* M.D., F.A.C.S., Boston; *Michael L. Mason,* M.D., F.A.C.S., Chicago; *Carl A. Moyer,* M.D., F.A.C.S., Dallas; *I.S. Ravdin,* M.D., F.A.C.S., Philadelphia. 665 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1951. Price $10.

This is not a textbook but a well-organized collection of the papers presented at a surgical forum in the Annual Clinical Congress of the American College of Surgeons held in 1950. Since 1941, the Surgical Forum has attracted growing interest at these annual meetings. As Doctor Wangensteen states, each year the creative and research ideas of some of the younger surgeons have been presented, stimulating each time a greater desire on the part of all who attended to have a larger understanding of surgery. There are 405 contributors to the book, and the medical centers which are represented cover North America. The book is unique in that under one cover there is a collection of articles which constitute the best offerings of American surgeons in surgical research for the year 1950. The individual papers are concise, well presented, and easily read.

The book deals with: (1) surgery of the lungs and esophagus, (2) surgery of the stomach, (3) surgery of the peritoneum, small and large bowel, and pancreas, (4) liver and bile ducts, portal caval anastomosis, and kidney, (5) cardiac surgery, (6) blood vascular system and blood flow, (7) neurosurgery, (8) wounds and wound healing, tissue transplantation, antisepsis, and antibiotics, (9) water, electrolytes, proteins, preoperative and postoperative care, fat metabolism, nutrition, and skin preparation, (10) blood transfusion, coagulation, shock, and hemorrhage, (11) malignancies and endocrines, and (12) anesthesia. The articles are well edited and illustrated. The index covers practically every subject that is of current interest in surgery.

—*Commander* J. M. Hanner, *MC, U.S.N.*

**A Synopsis of Surgical Anatomy,** by *Alexander Lee McGregor,* M.Ch. (Edin.), F.R.C.S. (Eng.), Senior Surgeon, Johannesburg General Hospital, Lecturer in Surgery, University of the Witwatersrand, with a foreword by *Sir Harold J. Stiles,* K.B.E., F.R.C.S. (Edin.). 7th edition. 778 pages; with 746 illustrations by *Dr. E. A. Thomas.* The Williams and Wilkins Co., Baltimore, Md., publishers, 1950. Price $6.50.

The author states that this is not intended to be an exhaustive exposition of the anatomy of the entire body and with this in mind the book has been written in outline form with brevity as the keynote. Each chapter is an essay in itself and the anatomic points are clearly and profusely illustrated with black and white diagrams that are a real aid to

the memory. The book is divided into "The Anatomy of the Normal" and "The Anatomy of the Abnormal." The latter includes such practical topics as the anatomic bases of clinical tests such as Trendelenberg's sign, the limps of poliomyelitis, and lesions of the intervertebral disks. The section on surgery of the sympathetic nervous system has been brought up to date and is made especially lucid by the use of the excellent diagrams. This book should be a valuable asset to the students of anatomy, to those surgeons who are preparing for various board examinations, to instructors of anatomy, and to those who are occasionally called on to lecture on surgical procedures.

—*Lt. (jg)* E. E. Bleck, *MC, U. S. N. R.*

**Know Your Teeth, A General Review of Everyday Questions (With Answers) asked Daily by Dental Patients, by *Walter Neal Gallagher,* D.D.S., Graduate of the School of Dentistry of Temple University, Philadelphia, Pa., Class of 1935; Intern at Forsyth Dental Infirmary for Children, Boston, Mass.; Intern at the Temple University Hospital, Phila., Pa.; Extern at Hahnemann Hospital, Philadelphia, Pa.; practiced General Dentistry, Hazleton, Pa.; 1936-1942; Member of the United States Naval Dental Corps; Member of the American Dental Association; Author of Complete Dental Review. 81 pages; illustrated. Exposition Press, New York, publishers, 1950. Price $2.**

This book is written in a clear, concise manner, using simple words understandable to a layman throughout, and consists of questions and their answers. It covers dental problems encountered from birth to their edentulous stage, explaining the formation and eruption of the teeth, caries, the effects of early loss of deciduous teeth, oral hygiene, orthodontics, dento-oral diseases, and prosthetics.

This book is highly recommended for laymen and dental technicians.

—*Lt. Col.* G. S. Moore, *U.S.A.F. (DC)*

**Psychiatric Aspects of Juvenile Delinquency, A study prepared on behalf of the World Health Organization as a contribution to the United Nations programme for the prevention of crime and treatment of offenders, by *Lucien Bovet,* M.D., Consultant in Mental Health, World Health Organization, Médecin-chef de l'Office Médico-pédagogique rattaché au Departement de Justice et Police de l'Etat de Vaud, Lausanne, Switzerland. 90 pages. Published by World Health Organization, Palais Des Nations, Geneva, 1951. Price $1.**

The author, appointed by the World Health Organization, presents a compact but comprehensive study of the current concepts of the problem of juvenile delinquency derived from consulting 150 specialists in this field and visiting 60 institutions in various European countries as well as in the United States. He does not attempt to offer any new solutions but presents an extensive review of the subject. The lack of precise and objective knowledge in evaluating this problem is emphasized and the semantic difficulties between various countries in the usage of the term "psychopath" is noted. Part of our difficulty in evaluating this problem is caused by the fact that it involves our moral customs, be-

liefs, and traditions and unconsciously mobilizes our own feelings of aggression and guilt. This is further indicated by the varied and ambivalent opinions concerning the type of punishment prescribed for the severe delinquent. The psychiatrist's approach to juvenile delinquency is emphasized but the sociologic, educational, and administrative aspects are discussed.

The first chapter deals with the general considerations of juvenile delinquency and includes various concepts of the definition of the juvenile delinquent from the viewpoint of the lawyer, teacher, social worker, and psychiatrist. Dr. Bovet summarizes juvenile delinquency as an artificial concept, legal and social in origin, that varies according to the laws in force or to the way in which they are applied, making it difficult to compare different countries or eras.

Chapter 2 concerns the etiology of juvenile delinquency and includes a discussion of some of the dynamics of normal social growth of the child, the development of the ego, and the pleasure and reality principles. Various viewpoints concerning the relative importance of the constitutional forces and the sociologic and environmental influences are presented in detail. Great emphasis is placed on the soil or constitutional contributions although the ease of mobilization of adverse behavior depends on the subject's personality, constitution, and life experiences and delinquency would appear to be a bio-psycho-social phenomena. Additional etiologic factors such as mental deficiency, organic disease and illness, partial retardation in development referring to faulty ego, and the controversial effects of cinema, television, radio, and comic strips on the genesis of delinquent behavior are discussed.

Chapter 3 describes methods of preventing juvenile delinquency and presents the various attitudes concerning such eugenic measures as sterilization and marriage prevention. Although not applicable on a large scale, the civil code in Switzerland provides for the possibility of preventing the psychopath from marrying. Emphasis is placed on the deleterious effect of prolonged hospitalization of children with exclusion of parental visits, too rigorously adhered to schedules of feedings, and uncertainty arising in mothers from poorly understood psychologic lectures currently most prevalent in the United States. Further suggestions for prevention are provisions for planned family holidays, improvement of housing facilities, and most important, child guidance clinics and their relationships to various community groups.

Chapter 4 presents various treatment measures, emphasizing the importance of diagnosis through recognizing the accidental delinquent and the psychologically severely disordered delinquent. The importance of psychiatric or psychologic examinations prior to commitment to reform schools or institutions and the relative advantages of outpatient treatment when possible in contrast to therapy in a detention environment are discussed. Important criteria for the personality of directors and staffs of reform institutions are formulated including the desirability

of their having been psychoanalyzed. The use of licensed hostels for delinquents on parole is considered efficacious.

A bibliography is included. This book represents an intensive review of the viewpoints of many authorities in this increasingly important field and is recommended to all those dealing directly or indirectly with this problem. —*Commander* C. H. Bagenstose, *MC, U.S.N.*

**Handbook of Diagnosis and Treatment of Venereal Diseases**, by *A. E. W. McLachlan*, M.B., CH.B (Edin.), D.P.H., F.R.S. (Edin.), Consultant in Venereal Diseases, Bristol Clinical Area; Lecturer in Venereal Diseases, University of Bristol; Honorary Consultant in Venereal Diseases, Bristol General Hospital; formerly Clinical Medical Officer, Joint Committee's Clinic, Newcastle General Hospital, Newcastle upon Tyne; Lecturer in Venereal Diseases, King's College, University of Durham; Assistant Medical Officer, Venereal Diseases Department, West London Hospital; Clinical Tutor in Venereal Diseases, University of Edinburgh, etc. 4th edition. 368 pages, with 160 illustrations; 20 in color. The Williams and Wilkins Co., Baltimore, Md., publishers, 1951. Price $4.50.

The first 10 chapters of this well-written handbook are devoted to the diagnosis and treatment of syphilis. The pictures are excellent. Although discussion must be limited in a book of this kind, the author calls attention to the most important aspects of this disease. Under treatment, great importance is placed on the use of penicillin in conjunction with arsenicals and heavy metal therapy. No reference is made to published results of research as to the efficacy of penicillin alone in comparison to the additional use of an arsenical. The public health importance of contact investigation and case finding is not discussed. This is now considered an important part of the management of syphilitic patients, because it is considered the duty of the doctor who diagnoses and treats syphilis to assist in stopping the spread of this disease in the community, as well as in preventing reinfection of the patient by the infected sexual partners.

The discussion of the diagnosis of syphilis, based solely on repeated positive serologic tests, is too general to be of much assistance on this most perplexing diagnostic problem. The expected serologic response following treatment for syphilis and the management of sero-resistant patients could profitably be expanded in this handbook.

Eight chapters are devoted to gonorrhea in both sexes. Since the advent of penicillin therapy, the complications of gonorrhea have ceased to be of prime importance, and a detailed discussion of examination and treatment would not be appropriate to a handbook. The ease of reinfection following treatment of gonorrhea with penicillin is not considered in the proposed follow-up period for proof of cure. This long period of follow-up seems unnecessary and of no value. No comment is made on the importance of the simultaneous treatment of known sexual partners to prevent "ping pong" infection, or on epidemiologic investigations.

The chapter on urethroscopy seems to be more appropriate for the specialist than for the general practitioner. With the recent advances in research with the newer drugs in the treatment of venereal diseases, the current literature is of the utmost value to the doctor who treats these diseases and should be employed by him for guidance. A handbook written today should call this fact to the physician's attention. This book is a valuable guide, particularly in the diagnosis of venereal diseases. Because of different concepts on the general practitioner's public health responsibilities in European countries and the United States, if falls short of meeting the requirements of this country from the public health point of view. —*Commander* L. E. Hedgecock, *MC, U.S.N.*

**Medical Psychology, A Basis for Psychiatry and Clinical Psychology, by *G. K. Yacorzynski,* Ph.D., Associate Professor of Nervous and Mental Diseases, Northwestern University Medical School. 535 pages; illustrated. The Ronald Press Co., New York, N.Y., publishers, 1951. Price $6.**

This text has the purpose of presenting "an integrated approach to the understanding of human behavior as a foundation for the study of psychiatry and clinical psychology * * * The method of presentation followed is to state only those theoretical constructs that have the widest acceptance and to give the experimental and clinical evidence from which they are derived * * * The book is intended primarily for use in a first-year course in psychiatry * * *" Part 1 is devoted to a discussion of basic psychologic principles in the areas of biologic needs, emotions, learning, perception, motives, and adjustment to conflicts. Part 2 deals with inheritance and maturation. Part 3 covers the structure and structuralization of personality. The author regards himself as having "endeavored to integrate the theoretical concepts of the behaviorist, Gestalt, and Freudian schools."

The purpose for which this book was written is indeed laudable. Students of medicine, psychiatry, and clinical psychology need fundamental training in the experimental approach to the understanding of human behavior. Systematic exposure to this influence should eradicate some of the mysticism with which contemporary clinical thought and practice abound.

Encouraged by the author's refreshing statement of intent, one might reasonably have expected a straightforward exposition, at the behavioral level, of the functional connections between stimulus and response components of psychologic events, augmented by a discussion of the observational methods by which such relationships have been established. This, after all, is the task of the psychologist. He works along a continuum of descriptional specificity, the experimentalist at one end seeking the broad, general principles which apply to a universe of phenomena; the clinician at the other end seeking the intimate and particular explanatory details. In this presentation, however, the author appears to have confused the terms "experimental" and "objective" with "biologic." The book turns out to be a frankly dogmatic attempt to force

concrete and specific behavioral phenomena into a biologic framework best signified, perhaps, by the term "homeostasis." Subsidiary dogmata include the familiar notion that behavioral phenomena are somehow mediated through transformations which occur within the organism, principally in the nervous system, For example, "these [past experiences] produce certain modifications in the nervous system, allowing learning to occur and perceptual processes to be established." Evidence for this assertion was apparently regarded as unnecessary; at least, the specific details were omitted. Later, this theoretical position poses difficulties even for the author, who observes that "it is necessary to distinguish between a true depression, in which the physiological functions are hypofunctioning, and a pseudodepression, in which the external behavior and demeanor of the individual display symptoms of depression but the physiological processes are normal or hyperfunctioning." What the harassed clinician can do about this unfortunate circumstance is not indicated.

Although the author's experimental evidence for broad correlations between concrete neurologic and psychologic events is slender, and specific correlations are lacking, there are occasional bursts of elaboration and refinement on matters not so controversial. For example, in a discussion of pH it is observed that "in neutral aqueous solutions there is always 1 gram of ionic hydrogen to 10,000,000 liters of water, or the ratio is 1/10,000,000, or 0.000 000 1, or $10^{-7}$."

Students trained in experimental psychology and scientific logic can probably distinguish, in most instances, between the factual and mythical pronouncements of the text. There are many commendable discussions of psychologic phenomena and their determinants, but they are difficult to disentangle from the profusion of dogmatic underbrush. Although this text is not likely to accomplish what it intended with the classes of students to which it was directed, I agree with the author's contention that there is a need for "an integrated approach to the understanding of human behavior as a foundation for the study of psychiatry and clinical psychology."—*Maj.* R. B. Payne, *U.S.A.F. (MSC)*

Chronic Ulcerative Colitis (Thrombo-Ulcerative Colitis), by *J. Arnold Bargen*, M.D., Division of Medicine, Mayo Clinic, Rochester, Minn. Publication Number 101, American Lecture Series. A Monograph in American Lectures on Abdominal Viscera. 62 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $2.

This monograph is clear and concise. Although the author, well known as an authority on this subject, rightfully allots most of the pages to the sections on diagnosis and treatment, the pathology and complications are adequately described. The optimism shown by Dr. Bargen makes this book worth any physician's time. He writes: "Probably no greater satisfaction can encompass an individual who is sick with uncontrollable bloody diarrhea and who is wasting away rapidly and visibly than to find himself lifted from the depths of despair, to regain his normal

health, and to resume again the activities of his former life. Yet such is the satisfaction offered to most patients suffering from this malady when they are willing and able to follow a well-ordered regimen of treatment and rehabilitation." Most military physicians will gain a new insight into the chronicity and disability of chronic ulcerative colitis through this book. Perhaps the prognosis of military patients with this condition would be improved if attempts were not made to return them to a duty status. —*Col.* H. C. Gibson, *MC, U. S. A.*

**Radiographic Atlas of Skeletal Development of the Hand and Wrist,** Based on the Brush Foundation Study of Human Growth and Development, initiated by *T. Wingate Todd,* M.B., Ch.B., F.R.C.S.; Late Henry Wilson Payne Professor of Anatomy in Western Reserve University School of Medicine; *William Walter Greulich,* M.A., Ph.D., Professor of Anatomy, Stanford University School of Medicine; formerly, Professor of Physical Anthropology and Anatomy and Director of the Brush Foundation, Western Reserve University School of Medicine; and *S. Idell Pyle,* M.S., Research Associate, Brush Foundation and Department of Anatomy, Western Reserve University School of Medicine. 190 pages; illustrated. Stanford University Press, Stanford, Calif., publishers, 1950. Price $10.

The assessment of the developmental status of children has long been a difficult problem. In 1937, Todd published his well-known "Atlas of Skeletal Maturation of the Hand" as a basis for determining developmental status. The present volume is a revision of his "Atlas" following 6 years' additional observation of a series of 1,000 normal children. Slightly fewer standards are included, and the present study extends to the age of 18 years. The book has four parts. There is a discussion of the assessment of developmental status from hand films. This includes comparison with other methods of maturity evaluation, the relationship of skeletal and reproductive system development, and the methods of assessing hand films and the normal deviations. Two parts are devoted to the male and female standards, and finally there is diagrammatic portrayal of the maturity indicators of each set of bones and epiphyses. As a basis for study of the normal development, this work is invaluable. In order to establish abnormality, graphic variants from each age group are included. The practicing physician might well desire a more precise estimate of the absolute limits of normal for a specific case. This is not feasible, for as the authors point out, "the variability inherent in skeletal development limits the precision of the techniques designed to assess it." The hand film remains the best single indicator of developmental status.

—*Maj.* L. H. Edelblute, *MC, U.S.A.*

**The Physiology and Pathology of Hemostasis,** by *Armand J. Quick,* Ph.D., M.D., Professor of Biochemistry, Marquette University School of Medicine. 188 pages, with 18 illustrations. Lea & Febiger, Philadelphia, Pa., publisher, 1951. Price $4.

The first part of this book, presents (1) an explanation for hemostasis which is consistent with known physiologic and clinical observations, this being quite different from the view of Petit that bleeding is con-

trolled by a clot which functions as a mechanical stopper; (2) a classification of hemorrhagic diseases with highlights in their diagnosis and surgical management; and (3) a chapter on venous thrombosis including its cause, its treatment, and the use of antithrombins and anticoagulants.

The author states that (1) less than 10 percent of the blood flow through skeletal muscle is under the control of the sympathetic nervous system; (2) not more than 1 percent of the maximum potential blood flow is required to meet the metabolic needs of the skin; (3) plasma is far more valuable in combating hemophilic hemorrhage than whole blood; (4) hematuria appears to be the most common and earliest form of bleeding caused by dicumarol therapy; (5) for surgical safety a prothrombin level of 40 percent or higher is required, and (6) in the diagnosis of hemorrhagic diseases the only tests needed in the majority of instances are determination of the bleeding time, prothrombin time, and prothrombin consumption.

Part 2 is devoted to 21 laboratory determinations and their clinical uses. This book should be of great value to the internist and surgeon.

—*Col.* A. E. White, *MC, U.S.A.*

Medical Neuropathology, by *I. Mark Scheinker,* M.D., Assistant Professor of Neuropathology and Assistant Professor of Neurology, University of Cincinnati College of Medicine, Attending Neurologist, Cincinnati General Hospital, Cincinnati, Ohio, Consultant Neurologist, Veterans' Administration Hospital, Fort Thomas, Ky., Consultant Neuropathologist, U.S. Public Health Service, Lexington, Ky.; with a foreword by *Marion A. Blankenhorn,* M.D., Professor of Medicine, University of Cincinnati College of Medicine, Director of the Medical Department of the Cincinnati General Hospital, Cincinnati, Ohio. 372 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $10.

This volume, by the author of Neurosurgical Pathology and Neuropathology in Its Clinicopathologic Aspects, deals with (1) the common nervous system complications of cardiac diseases, (2) functional and structural vascular syndromes, (3) chemotherapy and oxygen intoxications, (4) polyneuritis and neuritis, and (5) cerebral manifestations in blood dyscrasias, lung diseases, arterial hypertension, and liver diseases. The author describes cerebral complications of the more common internal diseases, correlating each type of cerebral lesion with its clinical counterpart. The chapter on cerebral manifestations in arterial hypertension is excellent as is the section on the Guillian-Barré syndrome. The gross and microscopic illustrations are exceptionally good.

—*Lt. Comdr.* W. H. Boswell, *MC, U.S.N.*

Cornell Conferences on Therapy, edited by *Harry Gold,* M.D., Managing Editor, *David P. Barr,* M.D., *McKeen Cattell,* M.D., *Frank Glenn,* M.D., *Walter Modell,* M.D., and *George Reader,* M.D. Vol. 4. 342 pages. The Macmillan Co., New York, N. Y., publishers, 1951. Price $3.50.

This volume of the Cornell Conferences on Therapy should be of great interest to clinicians, interns, and residents. The weekly conferences,

inaugurated at Cornell in 1937, are participated in by all departments of the Medical College and of the New York Hospital, as well as by authorities from other institutions. The spontaneous, informal, and free discussion stimulates interest in rational therapeutics. The topics discussed are of wide general interest, the discussions are uniformly maintained on a high level, and there is a free exchange of thought wherein various authorities present and defend their ideas.

—*Col.* R. E. Blount, *MC, U.S.A.*

**Hemodynamics in Failure of the Circulation,** by *W.B. Youmans,* M.D., Ph.D., Professor of Physiology, Department of Physiology, University of Oregon Medical School, Portland, Oreg., and *A.R. Huckins,* M.S., M.D., Research Assistant, Department of Physiology, University of Oregon Medical School, Portland, Oreg. 71 pages; illustrated. Publication Number 88; American Lecture Series. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $2.75.

In this short monograph, the authors clearly present their interpretation of circulatory failure, a subject which has in the past few years produced expressions of many controversial views. Following their division of the subject into chronic congestive failure and venous congestion without failure, they first briefly review certain basic physiologic principles. This is followed by a discussion of failure as caused by, (1) failure of venous return, and (2) failure of the ventricles. The remainder of the text is devoted to a discussion of chronic venous congestion without heart failure. Circulatory changes which occur in beriberi and in systemic arteriovenous fistula are used as examples. An excellent bibliography is appended, with a useful guide for selection of articles pertinent to various phases of the subject. The diagrams and schematic figures will prove useful to many, though the text is lucid. The book is recommended to all physicians who wish access to further knowledge on this important subject.

—*Col.* J. S. Taylor, *MC, U.S.A.*

**Annual Review of Medicine,** by *Windsor C. Cutting,* Editor, Stanford University School of Medicine; and *Henry W. Newman,* Associate Editor, Stanford University School of Medicine. Volume I. 484 pages. Annual Reviews, Inc., Stanford, Calif., publishers, 1950. Price $6.

Twenty-eight contributors present the 22 subjects discussed in this volume. An extensive bibliography is given at the end of each chapter. In the preface, the editors state that the more active fields of medicine will be reviewed annually, while other sections will be reviewed only every 2 or 3 years. The chapter on infectious diseases contains a good discussion of hemolytic streptococcal infections. The section on diseases of the gastrointestinal tract devotes too much space to the surgical treatment of ulcers, at the expense of discussion of medical aspects of these diseases. The chapter on medical aspects of cardiovascular disease is appropriately followed by one on surgery of the cardiovascular system. We have entered into a period of cardiovascular operations and although there is a relatively high mortality rate, we can

expect fewer failures in the future. It behooves medical men in general to become acquainted with these operations. The chapter on diseases of the kidneys includes timely reviews on the various classes and phases of kidney disease and its related chemistry.

It was gratifying to find a chapter on nutrition in medicine in this review. It is quite impossible to practice medicine these days without increasing attention to the effects of ovemutrition, malnutrition, and to the vitamin and electrolyte needs of the body. It was equally gratifying to see the section on radiobiology in the service of medicine. This chapter reviewed briefly the effects of atom bomb explosion. Radioactivity is so new and so important in the history of medicine that all new developments in this field should be brought promptly to our attention. Under the heading "Annotated List of Reviews in Medicine" is provided an excellent, rather complete list of references to medical reviews appearing in the literature between July 1948 and November 1949. The reviews cover a wide variety of subjects related to infectious diseases, diseases of the gastrointestinal tract, the cardiovascular system, hematology, nutrition, endocrinology, allergy, neoplastic diseases, respiratory diseases, the nervous system, and other matters. The chapters on diseases of the reproductive system, obstetrics, orthopedic surgery, and ear, nose, and throat are improperly placed in a review of medicine. Enough excellent material is published in the fields of internal medicine to warrant a review in that field alone. The idea behind the Annual Review is good, but the value of the present volume lies mainly in the bibliography.—*Commander* R. Volk, *MC, U.S.N.*

Current Therapy, 1951, Latest Approved Methods of Treatment for the Practicing Physician, edited by *Howard F. Conn,* M.D. Consulting Editors: *M. Edward Davis, Vincent J. Derbes, Garfield G. Duncan, Hugh J. Jewett, William J. Kerr, Perrin H. Long, H. Houston Merritt, Paul A. O'Leary, Walter L. Palmer, Hobart A. Reimann, Cyrus C. Sturgis,* and *Robert H. Williams.* 699 pages. W. B. Saunders Co., Philadelphia, Pa., publisher, 1951. Price $10.

The appreciation of any book on therapy is a difficult problem, because of the basic individuality of every medical man in handling his patients. Although the understanding of the patient and his illness is the best guide to therapy, all medical men need a consulting guide, a basic standard, a reminder of details; there is where I find the value in Current Therapy 1951. Dr. Conn presents a method of treatment, carefully edited by himself and a group of consulting editors. A group of 275 contributors have collaborated in this book. Advances in medical science are rapid and variable, and in the field of therapy the changes are so striking that it is difficult for the average medical man to keep up with the literature. This book will help him. Like the previous editions it can be recommended to all practitioners of medicine as a reference book.—*Lt. Col.* J. R. Vivas, *MC, U.S.A.*

**Pathology in General Surgery**, by *Paul W. Schafer*, M.D. 580 pages; illustrated. The University of Chicago Press, Chicago, Ill., publishers, 1950. Price $17.50.

This book, written primarily for surgeons by a surgeon with extensive experience in pathology, covers most of the more common conditions, as well as many of those less frequently seen by the general surgeon. Each disease process is discussed in the text and illustrated by color reproductions of both gross and microscopic specimens, as well as by roentgenograms in appropriate instances. Symptoms, signs, and clinical findings are correlated with pathologic alterations. Not only is the end result of the disease presented but also the various stages in its development. Differences of opinion are presented in some instances. The discussion in the text is brief, yet in most instances, adequate. A selected bibliography follows each presentation. Special fields including genitourinary, gynecologic, and orthopedic material are not presented.

The color reproductions are magnificent and the specimens used for illustration are well chosen. The book is clearly printed on good paper. A few typographic errors can be found. Although not all pathologists will agree with some of the interpretations made in the text and illustrations, the primary objective of the book, to bring about a correlation of pathologic findings with clinical observations, has been attained.

—*Col.* H. A. Van Auken, *MC, U.S.A.*

**Personnel Administration in Public Health Nursing**, by *William Brody*, Director of Personnel, New York City Department of Health; Lecturer in Public Health Administration, Johns Hopkins University; formerly Director of Personnel, National War Labor Board. 209 pages; illustrated. The C. V. Mosby Co., St. Louis, Mo., publishers, 1951. Price $3.25.

Personnel administration as an applied science has grown rapidly in recent years and its need and importance in health organizations as well as in other social and industrial organizations cannot be minimized. It is by sound and progressive personnel policies that health organizations can attract and hold well-qualified professional workers to carry out their objectives. In this book the author discusses briefly and simply the basic concepts and principles of personnel management as applied to the special problems encountered in public health nursing, though they may be applied to other fields as well. The first 10 chapters deal with the public health nurse and her position classification and job description; recruitment and selection policies; orientation and professional growth through in-service education; working conditions, including hours of duty, leaves of absence, salary, and environmental conditions; service evaluations; promotions; discipline, morale, and counseling; and retirement, transfers, and dismissals. There is considerable discussion of the merit system in public service and the place and function of the central personnel agency because over three-fourths of the public health nurses are Government workers employed by agen-

cies either entirely or partly tax supported. Many of the principles of the merit system are also applicable to non-Government agencies.

In the last chapter the author emphasizes the need for more democratic and progressive personnel administration in the public health organizations, especially because of certain factors characteristic of the organization and its personnel which have a tendency to hinder its progress. This is a well-written, easily readable volume which is valuable to the student, the public health nurse, and to any one associated with administration and personnel work, not only in public health nursing but in related fields as well. Throughout the book many references are cited and there is an excellent bibliography and index at the end.—*Capt.* A. E. Brimer, *U.S.A.F. (AFNC)*

**The 1950 Year Book of Dermatology and Syphilology,** (December 1949 – November 1950), edited by *Marion B. Sulzberger,* M.D., Professor and Chairman, Department of Dermatology and Syphilology, New York University Post-Graduate Medical School; Director of Dermatology and Syphilology, Skin and Cancer Unit and University Hospital, New York University - Bellevue Medical Center, and *Rudolf L. Baer,* M.D., Associate Professor of Clinical Dermatology and Syphilology, New York University Post-Graduate Medical School; Associate Director, Skin and Cancer Unit, and Attending Dermatologist, New York University Hospital. 497 pages; illustrated. The Year Book Publishers, Chicago, Ill., publishers, 1951. Price $5.

This annual digest of dermatology and syphilology appears in a new and pleasant format. This year's introductory monograph is on the treatment of pyodermas. The next 100 pages is devoted to a section on treatment. Other equally readable sections are those on clinical contributions and current investigation. A large portion of the volume is devoted to the dermatologic application and use of ACTH, cortisone, other steroids, hormones, vitamins and antibiotics. To many of the abstracts are appended refreshing editorial comments that add greatly to a proper appraisal of the articles reported on. Although the Year Book is very helpful to those interested in dermatology and syphilology, it also has a great deal to offer any physician who wishes to keep abreast of this specialty.—*Capt.* Robert L. Gilman, *MC, U.S.N.*

**Transactions of the American Goiter Association,** 1950 Annual Session, March 9, 10, 11, Shamrock Hotel, Houston, Tex. 445 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $11.50.

This fine book is full of words of wisdom. It contains 32 articles grouped in 7 symposiums, each of which is followed by a discussion printed in full and often quite valuable. The subjects of the symposiums are (1) diagnostic methods in the study of human thyroid disease, (2) radioiodine treatment of hyperthyroidism, (3) toxic effects of radioactive iodine, (4) the adrenals and thyroid disease, (5) exophthalmos, (6) cancer of the thyroid, and (7) nontoxic goiter. Six papers deal primarily with operations on the thyroid. The remainder deal with a medical or experimental approach to treatment.

Much of the material is of limited appeal and is over the heads of some educated in the pre-electronic age, especially those with no taste for mathematics. Some articles, however, would delight and inform any physician. The book is authoritative. Several of the articles are exhaustive. In general the conservative opinions of outstanding men from well known clinics here and abroad are presented. A survey of the still unanswered question of the mechanism of exophthalmus is enlightening. Another stimulating article takes issue with the time-honored theory of iodine lack and goiter belts. Articles on the thyroid in farm animals, surgical decompression of the orbit for extreme exophthalmos, a family of cretins, and the prevention of asphyxia with bilateral vocal cord paralysis indicate the scope of subjects.

This is primarily a specialists' reference book. Twenty-seven of the articles have been previously published in the Journal of Clinical Endocrinology.—*Commander* M. M. McLean, *MC, U.S.N.*

**Administrative Medicine**, by *Haven Emerson*, A.M., M.D., Editor, Professor Emeritus of Public Health, DeLamar Institute of Public Health, College of Physicians and Surgeons, Columbia University. 1,007 pages; illustrated. Thomas Nelson & Sons, New York, N.Y., publishers, 1951. Price $10.

More and more books on medical subjects are compilations of contributions from a panel of authorities, no one man wishing to pretend to a complete knowledge of even a relatively limited field. This volume is an encyclopedic work by 58 contributors. Although the editor contributes no chapter of his own, his name occurs in many of the selected lists of useful references which appear at the end of most of the chapters.

Part I on the organized care of the sick deals with various types of hospital, out-patient service, and rehabilitation. Part 2 on the administration and economics of medical care deals with various Government medical services, university health services, various voluntary medical care plans for the general public, and medical economics. Part 3 on public health administrative organization takes up official and voluntary health services from local rural through international organizations. Part 4 on the performance of public health services gets down to the administrative aspect of specific problems such as vital statistics, the control of various diseases, environmental sanitation, maternal and infant health, nutrition, health education, accident prevention, mental hygiene, and the training of public health personnel. The pages are printed in two columns to facilitate reading. Several of the longer chapters have a short summary.

It is unfortunate that there is no way to prevent specific cost figures from becoming rapidly obsolete. This applies especially to chapter 54 on the costs of public health services which was written in 1941. In a footnote the editor states his reasons for not bringing this chapter up to date. The chapter on medical service in the Armed Forces is likewise out of date. Among other things the complete separation of

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the Air Force from the Army is not mentioned. The coverage for the Army is better than that for the Navy. Despite these minor and perhaps unavoidable defects this reference work will be of great aid to students, teachers, and administrators for many years to come.

—*Col.* W. G. Brandstadt, *MC, U.S.A.*

The Neurosurgical Treatment of Traumatic Paraplegia, by *J. Laurence Pool,* M.D., Professor of Neurological Surgery, College of Physicians and Surgeons, Columbia University, New York, N.Y. Publication Number 83, American Lecture Series; A Monograph in American Lectures in Surgery. 107 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $3.

The diagnosis and treatment of spinal injuries commonly seen in civilian practice is the theme of this publication. No attempt is made to discuss similar wounds of war. One chapter is devoted to classification of spinal injuries from the point of view of cause and of pathologic changes in the spinal cord and the skeleton. Another deals with the physiology of injury to the spinal cord. Following these two preparatory chapters the aspects of diagnosis and treatment are covered from first aid through rehabilitation. Illustrative case histories are included. This concise discussion of the treatment of traumatic paraplegia written by a neurologic surgeon should be of more value to general surgeons and those physicians who are occasionally concerned with this type of patient, than to neurosurgeons.

—*Col.* J. W. Kemble, *MC, U.S.A.*

A History of Nursing, by *Gladys Sellew,* Ph.D., R.N., Chairman of Department of Sociology and Social Work, Rosary College, River Forest, Ill.; formerly Director, Department of Nursing, The College of St. Catherine, St. Paul, Minn.; formerly Visiting Professor of Nursing Education, The University of Maryland, Baltimore, Md., and *C. J. Nuesse,* Ph.D., Assistant Professor of Sociology, The Catholic University of America, Washington, D.C. 2d edition. 439 pages; illustrated. The C. V. Mosby Co., St. Louis, Mo., publisher, 1951. Price $3.75.

The authors contend that "nurses can gain insight into their own roles through the study of professional history in the light of social history." This brief history of nursing from early times to the present is interspersed with accounts of the progress of nursing as related to contemporary sociologic changes. The references given at the end of each chapter are mostly additional texts on nursing and sociology. Questions for study and discussion are also given at the conclusion of each chapter.—*Lt.* F. E. Quebbeman, *NC, U.S.N.*

Handbook of Antibiotics, by *A. L. Baron.* 303 pages. Reinhold Publishing Corp., New York, N.Y., publishers, 1950. Price $6.50.

This volume opens with an introduction in which are explained, the scope and limitations of the book, the method of certifying antibiotics, and the selection and registration of trade-marks for antibiotics. This is followed by brief comments as to the production, chemistry, bacteri-

ology, and pharmacology of 141 antibiotics. Each is followed by a bibliography. As a reference book this should prove extremely valuable especially for specific clinical uses and the bibliography.

—*Col.* A. E. White, *MC, U.S.A.*

**Perception—An Approach to Personality,** by *Robert R. Blake,* Associate Professor of Psychology, The University of Texas, and *Glen V. Ramsey,* Professor of Psychology, The University of Texas; in collaboration with *Frank A. Beach, Urie Bronfenbrenner, Jerome S. Bruner, Norman Cameron, Wayne Dennis, Else Frenkel-Brunswik, Carl Rogers, Ernest R. Hilgard, George S. Klein, Alfred Korzybski, James G. Miller, Louis J. Moran,* and *Clifford T. Morgan.* 442 pages; illustrated. The Ronald Press Co., New York, N.Y., publishers, 1951. Price $6.

This book represents 13 papers which were delivered at the 1949-1950 Clinical Psychology Symposium held at the University of Texas. Each contributor is a recognized authority in his field. A rather novel approach to an understanding of personality and interpersonal relations has been attempted in this volume. Apparently diverse approaches such as the chapter by Dr. Beach on body chemistry and perception and the chapter by Dr. Dennis on cultural and developmental factors in perception are presented in an attempt to construct a comprehensive theory of personality. The authors have done a creditable job in editing this complex and diverse material and have fused the various papers into a harmonious whole enabling the reader to peruse the volume without the feeling of frustration which often accompanies the reading of a book containing a series of contributions from different authors.

—*Lt. Col.* C. S. Gersoni, *MSC, U.S.A.*

**Maternal Care and Mental Health,** by *John Bowlby,* M.A., M.D., Consultant in Mental Health, World Health Organization; Director, Child Guidance Department, Tavistock Clinic, London. A report prepared on behalf of the World Health Organization as a contribution to the United Nations programme for the welfare of homeless children. 180 pages; 21 tables. World Health Organization, Palais des Nations, Geneva, Switzerland, publisher, 1951. Price $2.

The author prepared this exhaustive report for the World Health Organization as a contribution to the United Nations program for the welfare of homeless children throughout the world. In preparation for his study of the emotional needs of homeless children, he visited extensively in Europe and America and studied the pertinent literature in each country. His bibliography consists of 159 references. He cites many specific examples of how independent research conducted in many countries, has revealed the extensive and harmful consequences to the child's development of depriving him of maternal care at various periods of his early life. He emphasizes that even bad homes are often better than so-called good institutions or foster homes. Many different aspects of the subject are covered, including comparisons of Rorschach responses of maternally deprived children, the influence on children of neurotic and psychopathic parents, behavior disorders in children, the illegitimate

child, the adopted child, group care of deprived children, causes and prevention of family failure, and a host of allied subjects. The book is very easy to read. All psychiatrists should acquaint themselves with this book. In addition, there is invaluable background and reference material for social workers, psychologists, sociologists, and all those who are interested in or work in the broad field of mental hygiene.

—*Col.* F. R. Drake, *MC, U.S.A.*

Rice, Dietary Controls and Blood Pressure With Menus and Recipes, by *Frances I. Seymour,* M.D. 206 pages. Froben Press, Inc., New York, N.Y., publisher, 1951. Price $2.95.

This comprehensive and interesting book is written by a doctor who is afflicted by arterial hypertension and considered her return to comfortable living the result of treatment on the rice diet as prescribed by Kempner. She wrote the book as a source of information as well as an inspiration for a more optimistic outlook on life even in those who may consider themselves invalids. Much of the material is explanatory to the lay person but it is also helpful for the physician who is called on to treat hypertensive patients. In order to make the basic rice diet as enjoyable as possible, sample menus are presented. The last half of the book is devoted entirely to recipes stressing low sodium content. These recipes show an excellent "woman's touch." Modifications of the basic rice diet are offered for all patients—selected by their physician—who may tolerate certain additional items of diet. The book includes a chronologic outline story of the rice diet and tables giving the sodium and potassium analyses of foods as well as drinking water supplies of many parts of the United States.

—*Col.* U. R. Merikangas, *MC, U.S.A.*

Diseases of the Heart and Circulation, by *Paul Wood,* O.B.E., M.D. (Melbourne), F.R.C.P. (London), Director, Institute of Cardiology, London; Physician, National Heart Hospital, Physician in charge of the Cardiac Department, Brompton Hospital; Cardiologist, Rheumatic Fever Unit, Canadian Red Cross Memorial Hospital, Taplow; Late Consulting Cardiologist, Postgraduate Medical School of London, Hammersmith Hospital. 589 pages; illustrated. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1950. Price $12.50.

The author's purpose "to maintain a balance between man and his instruments, between experienced opinion and statistics, between traditional views and heterodox, between bedside medicine and special tests, between the practical and the academic" for graduates interested in cardiology has been magnificiently accomplished in this book. It presents a most balanced clinical approach to heart disease. All the modern physiologic concepts and the most recent developments of therapy and diagnostic methods have been clearly discussed. The author has included the current literature of both Great Britain and the United States in his references. Current information that is dispersed throughout a voluminous literature has been collected and emphasized in this treatise.

The title is somewhat misleading in that diseases of circulation here refers to those of the general circulation and not to peripheral vascular diseases. A noteworthy feature is the arrangement of electrocardiograms of various conditions about a triangle, the apices of which represent the respective location of the standard limb leads. This novel method of presentation clearly demonstrates the significance and the value of the unipolar and chest leads. In numbering illustrations, the author uses the chapter number and a serial subnumber.

The book is not a mere assemblage of facts and data but a well correlated study of each problem of cardiology. The author has placed the stamp of his individuality on the presentation. A few loose and inaccurate statements are scattered in the text, but do not detract from the merit of the book. Dr. Wood will undoubtedly correct these in future editions.—*Commander* H. A. Lyons, *MC, U.S.N.*

The Contribution of Surgery to Preventive Medicine, by *Sir James Learmonth,* K.C.V.O., C.B.E., Ch.M., F.R.C.S.E., Regius Professor of Clinical Surgery and Professor of Surgery, University of Edinburgh. 55 pages. Oxford University Press, New York, N.Y., publishers, 1951. Price $2.50.

The contents of this book were drawn from a series of lectures, known as the Heath Clark Lectures 1949, delivered at The London School of Hygiene and Tropical Medicine. The author draws attention to the fact that the practice of surgery in its special and general branches has contributed, and continues to contribute, to the field of preventive medicine. The specific instances of such contributions are too numerous to be listed here. Special emphasis is placed on Bacon's list of scientific qualities. The author has linked these qualifications with John Hunter, the great surgeon. I regret I had not the opportunity to hear these lectures as presented but the next best thing is being privileged to read them.—*Commander* J. A. Murphy, *MC, U.S.N.*

Diabetes Mellitus, Principles and Treatment, by *Garfield G. Duncan,* M.D., Clinical Professor of Medicine, Jefferson Medical College; Director of the Medical Divisions of the Pennsylvania Hospital and the Benjamin Franklin Clinic, Philadelphia, with the collaboration of *Ferdinand Fetter,* M.D., Assistant Professor of Medicine, University of Pennsylvania and Associate Physician to the Pennsylvania Hospital; *Perry S. MacNeal,* M.D., Associate in Medicine, Jefferson Medical College, Physician to the Pennsylvania Hospital and Associate in the Benjamin Franklin Clinic; *Barkley Beidleman,* M.D., Assistant in Medicine, Jefferson Medical College, Research Fellow and Assistant Physician to the Outpatient Department, Pennsylvania Hospital, and Associate in the Benjamin Franklin Clinic; and *Martha A. Hunscher,* B.S., Director of the Food Clinic, Pennsylvania Hospital. 289 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publisher, 1951.

Diabetes mellitus is a metabolic disorder which involves many fields of internal medicine as well as surgery. Dr. Duncan has provided a well ordered text covering all of the manifestations of this disease followed by notes on the recognition of the various complications and their treatment. He also has described the interrelationship of the pancreas

with the other organs and endocrine glands of the body. Liberal use is made of repetition for the purpose of amplifying the more important concepts, principally, that the overweight diabetic patient is usually refractory to insulin therapy and is more adequately controlled by reduction of weight. The problem of converting a diet prescription to a menu is simplified and a detailed discussion of the food exchange system is given. Here he stresses the increase in protein and carbohydrate in the diet at the expense of the fat content; the adequate control of the diabetes; and the value of instruction to the patient as means of avoiding or delaying subsequent complication. This book is well indexed and its presentation is on a very practical plane making it a valuable guide to any practitioner who does not manage diabetic problems as a specialty.—*Lt.* R. L. Fleck, *MC, U.S.N.*

**Patterns of Disease on a Basis of Physiologic Pathology,** by *Frank L. Apperly,* M.A., M.D. (Oxford), D.Sc. (Melbourne), F.R.C.P. (London), Professor of Pathology, Medical College of Virginia, Richmond, Va. 456 pages; 50 figures and 37 charts. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1951.

As stated in his preface the author purports to trace disease processes from their inception through the progression of "biochemical changes, altered function, altered anatomy and final cure or death," enumerating the compensatory mechanisms adopted by the body. By present-day standards he falls short of achieving this noble end. The book most closely resembles a compendium of lecture notes of great value, no doubt, to one who has attended the lectures, but representing only a bare outline of pathology and pathologic physiology to the casual reader. The presentation is orderly and systematic throughout but exceedingly elementary and dogmatic. The drawings are of value in depicting, broadly, disease patterns and the charts and tables serve as adequate summaries. No attempt is made to cover the morphology of disease in a manner to aid the physician at the autopsy table, microscope or in the clinical laboratory. No references to any of the basic literature are listed. The book would seem to be of greatest value to student nurses, medical technologists, and second-year medical students desirous of a quick review of basic principles prior to an examination in the didactic aspects of pathology.

—*Lt. Col.* F. A. Mantz, *MC, U.S.A.*

**Roentgenologic Diagnosis of Diseases of Bones,** by *David G. Pugh,* Assistant Professor of Radiology, Mayo Foundation, Graduate School, University of Minnesota; Consultant, Section on Roentgenology, the Mayo Clinic. 316 pages; illustrated. Thomas Nelson & Sons, New York, publishers, 1951.

This book consists of pages reprinted from Nelson's loose-leaf "Diagnostic Roentgenology." The pages are printed in two columns. Some of the illustrations are excellent and some are poor, but by and large they are useful. This book is designed to be a handy reference work and does not propose to deal exhaustively with the many subjects

discussed. It adequately reviews the broad field of diseases of bone, and if more detailed discussion is desired, reference may be made to the comprehensive bibliography included. The book is divided into sections on: (1) endocrine disturbances and allied disorders; (2) dystrophies and dysplasias of bone and allied diseases; (3) diseases of the hematopoietic and reticulo-endothelial systems; (4) infections of bone; (5) arthritis; (6) osteochondrosis and aseptic necrosis of bone; (7) bone tumors; and (8) osseous manifestations of chemical intoxications.

—*Maj.* J. C. Bates, *MC, U.S.A.*

**Growth and Development of Children,** by *Ernest H. Watson,* M.D., Associate Professor, and *George H. Lowrey,* M.D., Instructor, Department of Pediatrics and Communicable Diseases, University of Michigan Medical School. 260 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1951. Price $5.75.

The authors present a comprehensive review of growth and development from the fetal stage to adolescence. They bring together simply and clearly in a single small volume material which in most textbooks is sketchy and only superficially covered. This book discusses the following subjects: (1) heredity and environmental factors, (2) fetal growth and development, (3) normal physical measurements, (4) the premature child, (5) behavior development, (6) organ development, (7) osseous development, (8) role of endocrine glands in normal growth and development, (9) energy metabolism, (10) nutrition in normal growth, and (11) an outline of abnormal growth.—*Lt.* A. T. Henderson, *MC, U.S.N.*

**Tuberculosis Among Children and Adults,** by *J. Arthur Myers,* M.D., Ph.D., Physician in Charge, Chest Clinic, Students' Health Service, University of Minnesota; Chief of Tuberculosis Service, Minneapolis General Hospital; Professor of Medicine, Preventive Medicine, and Public Health, Medical and Graduate Schools, University of Minnesota, Minneapolis, Minn., with an introduction by *Allen K. Krause,* M.D., Late Lecturer in Medicine, Johns Hopkins University; Past Editor, American Review of Tuberculosis, Baltimore, Md., with chapters by *O. Theron Clagett,* M.D., F.A.C.S., *William S. Conklin,* M.D., F.C.C.P., *Jerome R. Head,* M.D., F.A.C.S., *Ralph C. Matson,* M.D., F.A.C.P., F.A.C.S., F.C.C.P., *John D. Steele,* M.D., F.A.C.S., and *C. A. Stewart,* M.D., Ph.D. 3d edition. 894 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $12.50.

This book is dedicated "To the Memory of Francis E. Harrington, Charles A. Steward and Herbert A. Burns with whom I labored for twenty-five years to establish fundamentals in tuberculosis control and eradication." All who know of the author's work will appreciate the appropriateness of this dedication. The third edition of this standard textbook brings up to date our information on tuberculosis control and clearly demonstrates that prevention of any form of tuberculosis is the best way to eradicate the disease. I recommend this book to all practitioners of medicine and especially to those working in tuberculosis control.—*Lt. Col.* J. R. Vivas, *MC, U.S.A.*

Medical Mycology, by *Frederick Reiss, R. M. Archibald, Rhoda W. Benham, Arturo L. Carrion, Amos Christie, Norman F. Conant, Carroll W. Dodge, Lucille K. Georg, Henri Gougerot, Alexander M. Iams, Donald S. Martin, Morris Moore, Samuel M. Peck, William J. Robbins, S. B. Salvin,* and *Fred D. Weidman.* Editor, *Roy Waldo Miner;* Associate Editor, *B. J. Henegan;* Consulting Editor, *Frederick Reiss.* Volume 50, Art. 10. Pages 1209-1404 of Annals of The New York Academy of Sciences. Illustrated. The New York Academy of Sciences, New York, N.Y., publisher, 1950. Price $2.75.

This monograph is a collection of articles presented before the New York Academy of Sciences in 1947. The authors of the individual papers are authorities in the field of medical mycology and as such present in concise form the best opinion on laboratory, clinical, epidemiologic, and therapeutic procedures. Little new is added but the old is ably collected and clarified. Some provocative speculation as to susceptibility is presented by Dodge. The investigations into the nutriment requirements of various pathogenic fungi may open a new approach to therapy. The monograph is recommended to mycologists, dermatologists, and clinical pathologists.—*Col.* V. R. Hirshmann, *MC, U.S.A.*

Yellow Fever, by *George K. Strode,* M.D., Editor, and *John C. Bugher,* M.D., *J. Austin Kerr,* M.D., *Hugh H. Smith,* M.D., *Kenneth C. Smithburn,* M.D., *Richard M. Taylor,* M.D., *Max Theiler,* M.R.C.S., L.R.C.P., *Andrew J. Warren,* M.D., and *Loring Whitman,* M.D. 710 pages; illustrated. McGraw-Hill Book Co., Inc., New York, N.Y., publishers, 1951. Price $9.50.

Dr. Strode and eight associates of the International Health Division of the Rockefeller Foundation have written and compiled a monumental textbook on yellow fever. It is well-illustrated and easily read. The average physician, trained in the temperate zone, is perhaps apt to feel that yellow fever is just another tropical disease and not his concern, especially since Walter Reed and his assistants solved the problem back in the early 1900's. Jungle yellow fever and *Haemagogus* mosquitoes are unknown to him, and he has forgotten the potential danger of "yellow jack" wherever *Aedes* mosquitoes exist.

This book is not a textbook in the sense that it should be part of the assigned reading of medical students. Eighty-one pages are devoted to mammalian hosts, 65 to vectors, and 93 to the virus itself. This illustrates the completeness with which the Foundation personnel have prepared this book. Certainly all teachers of preventive and tropical medicine, all reference libraries, and those with special interest in the control of arthropod-borne diseases will find a wealth of material in it.

It has taken years of hard work, international cooperation, millions of dollars, and many lives to prove that this scourge of the Tropics could be brought under control. The medical officer on duty with the Armed Forces does not need this book in his personal library, but it should be available to him especially when he is on duty in a potential.

yellow fever area. The chapters on epidemiology and control are excellent.—*Col.* C. H. Morhouse, *U.S.A.F. (MC)*

**Handbook of Chemistry,** A reference volume for all requiring ready access to chemical and physical data used in laboratory work and manufacturing. Compiled and edited by *Norbert Adolph Lange,* Ph.D., Lecturer in Chemistry at Cleveland College of Western Reserve University; Member of the American Chemical Society, and American Institute of Chemists. Assisted by *Gordon M. Forker,* B.S. (Chem. Eng.) General Electric Company, Cleveland, Ohio. 7th edition. 1,920 pages. Handbook Publishers, Inc., Sandusky, Ohio, publishers, 1949. Price $7.

This compilation of physical and chemical data on most common and many uncommon materials has been well printed on good paper and well bound for books of this type. It is fairly comprehensive but is not too bulky or unwieldy for convenient use at desk or work bench. Some mathematical tables have been eliminated in favor of new tables dealing with properties of hormones, dipole moments, dielectric constants, and viscosities of aqueous sucrose and ethanol solutions. Other tables have been rewritten and brought up to date. Handbooks of this type are essential for the working scientist and for medical officers with laboratory interests. This edition recommends itself in encompassing an adequate coverage of material in a moderately sized volume.

—*Lt. Col.* M. E. Freeman, *MSC, U.S.A.*

**Medicine of the Year.** Internal Medicine, by *Hugh J. Morgan,* M.D., Professor of Medicine, Vanderbilt University; Psychiatry, by *Franklin G. Ebaugh,* M.D., Professor of Psychiatry, University of Colorado; Obstetrics and Gynecology, by *Frank Whitacre,* M.D., Professor of Obstetrics and Gynecology, University of Tennessee; Pediatrics, by *Mitchell I. Rubin,* M.D., Professor of Pediatrics, University of Buffalo; General Surgery, by *Warren H. Cole,* M.D., Professor of Surgery, University of Illinois. 3d issue. Editorial direction by *John B. Youmans,* M.D., Dean, School of Medicine, Vanderbilt University. 298 pages. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1951. Price $5.

This is a well written summary of important developments in most fields of clinical medicine during 1950, presented in sections devoted to: (1) internal medicine, (2) psychiatry, (3) obstetrics and gynecology, (4) pediatrics, and (5) general surgery. Subsections cover most of the remaining clinical specialties. Each subdivision is preceded by a short general description of its contents and is followed by a bibliography. The volume as a whole has an excellent subject index and an index of all the authors referred to in text or bibliography. The editorial staff includes some of the outstanding authorities in each of the fields covered. The advances, concepts, and developments selected for review or comment are in general well chosen from the voluminous literature available and are documented by references to basic publications, most of which appeared in 1950. The book should serve as an invaluable aid to the physician who wishes to keep abreast of medicine in fields outside his own since the trends are presented in an informative and critical manner.

Because such a large amount of information is summarized in a very few pages it is inevitable that an occasional error will appear which, if taken literally and without reference to the excellent bibliography provided, might lead to embarrassing consequences. A case in point appears on page 189, where Rice et al. are quoted as recommending (for the maintenance of nutrition in debilitated patients) the intravenous administration of a solution containing 5 percent amino acids, 5 percent glucose and 60 percent of 98 percent alcohol per 1,000 cc. A check with the original publication reveals that the solution recommended should contain 5 percent amino acids, 5 percent dextrose and 60 cc. of 98 percent alcohol per 1,000 cc. In this edition the outside dimensions have been reduced from the 11¼ by 8¾ inches of the two preceding issues to 9¼ by 6½ inches and the number of pages increased from 204 to 298. The scope, volume, and arrangement of contents remain much the same as before.—*Col.* A. A. Biederman, *MC, U.S.A.*

**The Naval Officer's Manual,** A Ready Reference of Helpful Information and Counsel for All Officers of the United States Navy and the Marine Corps. 333 pages; illustrated. The Military Service Publishing Co., Harrisburg, Pa., publishers, January 1951. Price $3.50.

This book is completely up to date. It not only describes the organization of the Navy but also the interrelationships between the Navy and the other two branches of the Armed Forces which have resulted from the National Security Act of 1947. It is written primarily from the viewpoint of the line officer and has as its basic thesis the teamwork that is necessary for the Navy to carry out its mission as a combat organization. Such a book can be very useful to medical officers who, in addition to their professional duties as physicians in a military organization, are constantly being confronted with problems of naval customs and traditions, uniform regulations, discipline, administration, and the new code of justice. These matters are presented clearly and concisely.

The manual describes in detail the organization and responsibilities of the various departments aboard ship and in shore establishments, including the activities of the various naval schools for the training of officer and enlisted personnel. Much attention is given to public relations and public speaking. The chapter on personal matters is of particular importance to all officers having families. It discusses many problems that are constantly occurring, such as commissary and ship service privileges, transportation of dependents, shipment of household effects, allotments of pay, joint bank accounts, granting powers of attorney, wills, hospitalization of dependents, the Navy Relief Society, insurance coverage, and retirement procedures and privileges. The wives will be interested in the information on accepted social customs which have long characterized the high standards of naval life.

—*Rear Adm.* F. C. Greaves, *MC, U.S.N.*

**Blood Groups in Man**, by *R. R. Race*, Ph.D. (Cantab.), M.R.C.S. (England), Director, Medical Research Council Blood Group Research Unit, Lister Institute, London, and *Ruth Sanger*, Ph.D. (London), B.Sc. (Sydney), Medical Research Council Blood Group Research Unit, Lister Institute, London, with a foreword by *Professor R. A. Fisher*, F.R.S. 290 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1950. Price $6.50.

This book is primarily a reference book for those interested in the technical field of blood groups. It is a well written detailed account of the progress made in this field, especially during the past 10 years. The authors discuss in detail the voluminous amount of investigative work from various research centers, including their own. The bibliography is extensive. The authors bring up to date in one volume the present status of systems of blood groups, including the more recent Rh and MN subdivisions and those of Lutheran, Kell, Lewis, and Duffy. Discussions of special technics used in blood group investigations are presented. Difficulties encountered and pitfalls to be aware of in developing and using some of the serum containing antibodies are pointed out. The authors stress the hereditary factor found in the blood groups. The average busy practitioner would find this book too detailed and of little clinical interest, but the authors promise to publish a book devoted to the clinical application of the blood groups later. The present volume will be of particular value to physicians concerned in certain medicolegal cases; one chapter is specifically devoted to the problems of parentage and identity. Several excellent charts outlining possible combinations and the problem of exclusion of paternity are included.

—*Lt. Col.* D. O. Lynn, *MC, U.S.A.*

**Ambulation**, Physical Rehabilitation for Crutch Walkers, by *Kenneth A. Dening*, B.S., M. Ed., and *Frank S. Deyoe, Jr.*, B.S., Instructor-Supervisors, Corrective Therapy, Cushing Veterans Administration Hospital, Framingham, Corrective Therapists at Boston City Hospital, Boston, and Medford Ambulation Clinic at Medford, in Massachusetts, and *Alfred B. Ellison*, B.S., Chief, Corrective Therapy, Cushing Veterans Administration Hospital, Framingham, Corrective Therapist at Boston City Hospital, Boston, and Medford Ambulation Clinic at Medford, in Massachusetts. 188 pages; illustrated. Funk and Wagnalls Co., New York, N.Y., publisher, 1951. Price $3.50.

This small, well-organized volume presents a pictorial and word description of the basic technics to be used in a program of physical rehabilitation of paraparetics and paraplegics. The language is nontechnical for the benefit of the patient and lay instructor. The material has been gathered from medical literature and clinical experience. The proposed procedures, graduated from the simple to the complex, have been proved by experience and have the sanction of long use. Emphasis throughout the text is on education in self-care and self-propelled locomotion as a means of acquiring some degree of independence in daily living. Though this manual has been prepared for the severely disabled

and for those who are interested in the rehabilitation of such handicapped persons, the methods and procedures are readily adaptable to less severe types of injury or disease in which crutches are required. This book, consequently, should be in the hands of every worker in the field of physical rehabilitation and also made available to those persons whose disabilities are sufficiently extensive to impose a prolonged period in a wheelchair or on crutches.—*Lt. Col.* J. B. Parsons, *U.S.A.F. (MSC)*

**Syllabus of Human Neoplasms**, by *R. M. Mulligan*, M.D., Professor of Pathology in the University of Colorado School of Medicine. 317 pages; with 230 illustrations. Lea & Febiger, Philadelphia, Pa., publisher, 1951. Price $7.50.

This book offers concise, lucidly written, and carefully edited descriptions covering most human neoplasms, benign as well as malignant, illustrated by numerous, original, well reproduced photomicrographs. The discussion of each neoplasm usually covers no more than ¾ of a page, yet includes a brief list of typical clinical findings; unusually complete, useful statistics; as well as a clear and detailed description of gross and microscopic characteristics. The references are grouped after each chapter and do not intrude into the writing. Although the section on neoplasms of blood cell origin will certainly arouse the old arguments over terminology and interrelationships, the chapter on neoplasms of female genitalia is especially well written. For its size, this book is remarkably complete and well condensed. It should be particularly useful for quick reviews and in preparing for clinicopathologic conferences.—*Lt.* C. G. Bratenahl, *MC, U.S.N.*

**The 1950 Year Book of Pathology and Clinical Pathology** (January-December 1950). Pathology edited by *Howard T. Karsner*, M.D., LL.D., Medical Research Advisor to the Surgeon General, United States Navy. Clinical Pathology edited by *Arthur Hawley Sanford*, M.D., Professor of Clinical Pathology, University of Minnesota (The Mayo Foundation); Emeritus Consultant, Division of Clinical Laboratories, Mayo Clinic. 454 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publisher, 1951. Price $5.

This book is composed of abstracted articles carefully selected from the world literature of 1950. Each phase of anatomic and clinical pathology is covered and the material is arranged in a manner similar to that found in most textbooks on these subjects. Many of the articles are selected from regional journals, foreign literature, and other publications found only in large medical libraries and not readily available to most physicians. Frequent short comments by the editors are helpful in evaluating the material. The opening article is a summary by Selye on the present status of the adaptation syndrome. Several articles on cancer research indicate the trends of investigation in this field. The endocrine glands are widely covered, including many articles concerning the adrenal cortex. The chapter on cardiovascular pathology includes current investigations of the causes of arteriosclerosis. Several articles concerning lupus erythematosus and the L.E. cell are of special

interest. Studies on the effects of beryllium, new types of pneumoconiosis, streptomycin effects in tuberculosis, the coxsackie virus, and chemical tests for malignancy are included. There is a chapter on cytology. Many new, improved, and simplified laboratory procedures are discussed giving the technics in detail. The Year Book Quiz is a valuable adjunct to the text. The book is highly recommended for physicians who desire to keep abreast of current developments in this important field of medicine.—*Lt. Comdr.* A. F. Braff, *MC, U.S.N.*

**Post-Graduate Lectures on Orthopedic Diagnosis and Indications**, by *Arthur Steindler*, M.D., F.A.C.S., Professor of Orthopedic Surgery, State University of Iowa, Iowa City, Ia. Volume II, Section A: Paralytic Disabilities; Section B: Static Disabilities. 198 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $6.

This book is the second volume in a projected series of four. The first dealt with preliminary instruction in orthopedic diagnosis, and congenital deformities. In the present volume, Dr. Steindler outlines the most important orthopedic aspects of poliomyelitis (devoting almost one-third of the volume to this topic), scoliosis, spastic paralysis, low back pain, and static disabilities of the knee, foot, and ankle. Each topic is carried from the basic considerations of anatomy, pathogenesis, and pathology through clinical diagnosis to the nonoperative and operative treatment. The author indicates his own choice of treatment, the results of that treatment at his clinic, and often other accepted means of treatment. It is not possible, in a volume of this size, to cover these topics exhaustively, but the author has compressed into relatively small space a surprisingly comprehensive amount of basic information. He gives in didactic form the conclusions from his careful analysis of a vast clinical experience. The volume is especially recommended to the orthopedic resident and affords valuable reading to all interested in orthopedic subjects.

—*Lt. Comdr.* G. C. Beattie, *MC, U.S.N.*

**A Textbook of X-ray Diagnosis**, by British Authors, in Four Volumes. Edited by *S. Cochrane Shanks*, M.D., F.R.C.P., F.F.R., Director, X-ray Diagnostic Department, University College Hospital, London, and *Peter Kerley*, M.D., F.R.C.P., F.F.R., D.M.R.E., Director, X-ray Department, Westminister Hospital, Radiologist, Royal Chest Hospital, London. 2d edition, Volume II. 702 pages; 605 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1951. Price $15.

This volume deals with the chest, and replaces volume 1 of the first edition. The portion of the latter covering the chest contained 479 pages as compared with the present 702 pages giving some idea of the comprehensive nature of the new edition. Part 1 embraces the cardiovascular system, its greater scope being chiefly attributable to the advent of angiocardiography in the intervening 10 years. No illustrations of the normal angiocardiogram are included and only a few angiocardiograms are presented in the chapter on congenital diseases of the heart

and great vessels. A more inclusive clinical correlation would also have been a valuable addition. Semidiagrammatic colored drawings of the normal cardiovascular shadow in the various projections have been added which are helpful in correlating the normal anatomy with the radiologic appearance. Following a description of the normal cardiovascular shadow, the diseases which involve the heart and great vessels are discussed in an easily read and adequate manner. The chapter on the peripheral vessels is the least comprehensive and little of practical value is included concerning venography.

Part 2 considers the respiratory system, and is fully illustrated. Greater and deserved emphasis has been placed on the bronchopulmonary segments as a consequence of the rapid advances in the realm of chest disease, although the British terminology is used exclusively and no comparison is made with the method of Jackson and Huber more commonly used in this country. The normal anatomy of the respiratory system is well covered, and is illustrated by line drawings. This is followed by a discussion of the various disease processes. There is a final brief chapter on the roentgenographic appearances of the lungs following pneumothorax and surgical procedures.

The paper and binding are of excellent quality and the radiographic reproductions are uniformly excellent. The reproductions in the positive phase should only mildly disconcert the American reader.

—*Lt.* J. C. Bacon, *MC, U.S.N.*

**Anesthesia in Dental Surgery**, by *Sterling V. Mead*, D.D.S., M.S., B.S., F.A.C.D. 2d edition. 648 pages; with 212 illustrations. The C. V. Mosby Co., St. Louis, Mo., publisher, 1951. Price $12.50.

This book, the first edition of which was published in 1935, is an excellent addition to the dental and oral surgical practitioner's library. Although at times cursory in its presentation of the physiologic aspects of anesthesia it elaborates on those particular agents most commonly used in dental anesthesia. It is divided into two portions. The first concerns primarily local anesthesia. Following the introductory pages which are devoted to an excellent discussion on the choice of anesthetic agents and the value of a thorough preanesthetic physical examination, a review of related systemic pathology is presented. The historic discussion on the chronologic development of local anesthesia which follows leads into a presentation on the related anatomic structures, osteologic, muscular, neurologic, and vascular. The author then presents and elaborates on the pharmacology, armamentaria, technics of administration, accidents, complications, and postoperative sequelas associated with local anesthesia.

In a like manner the second portion deals with the many and varied aspects of general anesthesia. Following some interesting anecdotes on the historical background of general anesthesia, a practical presentation on the physiology of general anesthesia is given, followed by a

section on preanesthetic medication. In the discussion on intravenous, inhalation, and rectal anesthesia, particular attention is given to nitrous oxide, sodium pentothal, ethyl chloride, vinethene, and avertin. The concluding chapters, which present the complications and untoward sequelas of general anesthesia, the uses and abuses of the analeptic drugs, and the various emergency measures and methods of resuscitation in anesthetic accidents should be of exceptional value to the dental anesthetist. —*Maj.* A. M. Mohnac, *U.S.A.F. (DC)*

**The Kidney**, Medical and Surgical Diseases, by *Arthur C. Allen*, M.D., Pathologist, The James Ewing Hospital; Assistant Attending Pathologist, Memorial Cancer Center, New York City; Attending Consultant in Pathology, Veterans Administration Hospital, Bronx, N.Y. 583 pages; 1115 illustrations. Grune & Stratton, New York, N.Y., publisher, 1951. Price $15.

This is an excellent treatise on the pathology and pathophysiology of the kidney. The illustrations are profuse and bring out many new concepts in the disease processes of the kidney. The book discusses the embryology, anatomy, normal and abnormal physiology of the kidney, followed by a complete discussion of uremia. The diseases are presented by describing their effects on the glomeruli and various tubules. The illustrations, although in black and white, are well chosen and cover the subject. Glomerulonephritis, its classification, pathology, and physiology, is well presented and illustrated. This might be described as an atlas of renal pathology, correlating insofar as possible, the disturbed physiology with the anatomic changes. The bibliography is extensive and up to date.—*Lt. Comdr.* W. W. Miller, Jr., *M C. U.S.N.*

**Clinical Heart Disease**, by *Samuel A. Levine*, M.D., F.A.C.P., Clinical Professor of Medicine, Harvard Medical School; Physician, the Peter Bent Brigham Hospital, Boston; Consultant Cardiologist, Newton-Wellesley Hospital; Physician, New England Baptist Hospital. 4th edition. 556 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1951. Price $7.75.

This new edition brings up to date one of the foremost texts on heart disease. Through the years this book has become a standard reference work for students and clinicians. The new edition, like the earlier ones, stresses the clinical aspects of heart disease. It does not contain any bibliography because it generally expresses the personal opinions of the author. This does not detract from the book because Dr. Levine is an acknowledged authority, an astute clinical observer, and a master teacher. The book makes easy and enjoyable reading. There are no illustrations except in the section on electrocardiography. The greatest revision is found in the sections on the surgical treatment of mitral stenosis, congenital heart disease, and hypertension. The use of anticoagulants, especially in myocardial infarction, is also covered. The use of diets in the treatment of hypertension and congestive heart failure has been added. No mention is made of the use of ACTH and

cortisone in the treatment of acute rheumatic fever. The section on electrocardiography has been completely rewritten and greatly expanded. The use of multiple precordial leads and the new unipolar leads is adequately covered. Here again the emphasis is placed on the clinical aspects. —*Col.* E. M. Goyette, *MC, U.S.A.*

**Clinical Laboratory Methods,** by *W. E. Bray,* B.A., M.D., Professor of Clinical Pathology, University of Virginia, Director of Clinical Laboratories, University of Virginia Hospital. 4th edition. 614 pages; with 119 text illustrations and 18 color plates. The C. V. Mosby Co., St. Louis, Mo., publisher, 1951. Price $7.25.

This new edition of a well-known textbook includes the current trends in laboratory procedures. It is unfortunate that the role of the photoelectric colorimeter and spectrophotometer in the laboratory are only briefly mentioned and most of the blood chemistry determinations are based on visual colorimetry. A chapter which should be of great help to the busy clinician is devoted to selected laboratory work on special cases and on various services. Although the title gives the impression that the book deals with methodology alone, brief interpretations of findings are included. The format is good and the illustrations are excellent. —*Commander* V. E. Martens, *MC, U.S.N.*

**Emotional Factors in Cardiovascular Disease,** by *Edward Weiss,* M.D., Professor of Clinical Medicine, Temple University School of Medicine, Philadelphia, Pa. Publication Number 97, American Lecture Series. A Monograph in American Lectures in Circulation. 84 pages. Charles C Thomas, Publisher, Springfield, Ill., 1951. Price $2.25.

The author of this monograph discusses the psychosomatic aspects of (1) functional heart disease with its symptoms and treatment, (2) neurocirculatory asthenia, (3) hypertension and hypotension, and (4) psychosis in cardiac disease. He believes that cardiac neurosis arises in psychologically predisposed persons who have been subjected to a precipitating factor, such as the statement of some physicians that the heart shows some abnormality, the occurrence of some dramatic case of heart disease among relatives or friends, some profound and protracted emotional disturbance, or the appearance of some symptom which calls the patient's attention to his heart. The author emphasized the importance of explaining the illness to the patient. The format and binding are excellent. This monograph is apparently written for medical students and adds little to the knowledge of the general practitioner or internist.
— *Col.* F. H. Mowrey, *MC, U.S.A.*